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Great Plains Agricultural Council

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16. ABSTRACT

The Committee on Social and Economic Implications of Energy Extraction, Conversion, and Transportation (GPC-8) of the Great Plains Agricultural Council sponsored a workshop on Modeling Local Impacts of Energy Development in Denver, Colorado in March, 1980. The workshop included nine major papers, each dealing with the current state of the art and/or new concepts in the development and utilization of socio-economic impact models. Following presentation of the papers, a panel of five persons representing agencies which utilize impact assessments or organizations which conduct such assessments discussed the papers and provided recommendations for future research emphases.

Topics which were emphasized in the workshop included:

1. Present status of socioeconomic impact models and techniques with recommendations for future work.
2. Long-term structural changes in rural economies and their implications for impact modeling.
3. Labor market implications of large-scale energy development.

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Problems of Modeling Local Impacts of Energy Development

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March 18-19, 1980

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Foreword

The papers in this publication were presented at a workshop on "Modeling Local Impacts of Energy Development" held in Denver, Colorado, March 18-19, 1980. Sponsored by the Great Plains Agricultural Council Coordinating Committee on Social and Economic Implications of Energy Extraction, Conversion, and Transportation (GPC-8), the program was developed in response to a widespread interest in the evaluation and subsequent management of local economic, demographic, public service, fiscal, and social impacts of energy resource development. By comprehensive analysis it was hoped that problems associated with socioeconomic impact modeling could be brought into sharper focus thereby enhancing significant cooperative efforts by research organizations in the Great Plains towards solution of the problems.

The individual papers represent thoughtful and searching evaluations and interpretation from several perspectives. These papers deal with the following major topics:

1. Present status of socioeconomic impact models and techniques with recommendations for future work.
2. Long-term structural changes in rural economies and their implications for impact modeling.
3. Labor market implications of large-scale energy development.
4. Advanced approaches to impact assessment and to utilization of large data bases.
5. Use of impact models and assessments in the policy/decision making process.

Overall, then, the papers describe the current state of knowledge in assessing the economic and social effects of large scale development projects and also point out the continuing need for research to produce workable solutions for problems in an ever-changing society.

In summary, it was recognized that the job ahead is large, complex, challenging, and well worth doing. Through sincere, unselfish cooperation our ability to meet the challenge will be enhanced.

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A REVIEW OF THE STATE-OF-THE ART
IN LOCAL IMPACT ASSESSMENT

Dean C. Coddington
John S. Gilmore 1/

INTRODUCTION

The findings in this paper are based on more than 50 research projects of socioeconomic impacts. Half of these projects have been carried out for industrial clients and specifically relate to coal mines, uranium mills, power plants, or other capital intensive new facilities. A model (or more correctly "approach") was applied to estimate socioeconomic impacts in all of these studies.

We first became generally concerned about the impacts of energy development in the late 1950's and early 1960's when there was initial talk about the possiblility of oil shale industry being developed in western Colorado. The potential for local area impacts resulting from oil shale development obviously is very significant, and this has spurred many subsequent research projects. Unfortunately, none of the studies have ever been validated since no oil shale development has ever taken place.

We were involved in a large research project in the mid 1970's which attempted to estimate the local area impacts of a large coal-oil-gas (COG) plant in southwestern North Dakota. Three locations within this broad region were selected for differences in impacts likely to result if such a plant were to be located in an isolated rural area or near more developed areas like Bismarck. This research effort was also our first exposure to the world of fiscal impact modeling.

More recently, DRI conducted the large research effort sponsored by the Council for Environmental Quality (CEQ) which led to the development of a socioeconomic impact model. This integrated model has been computerized and now joins a host of others in this category.

1/ Mr. Coddington is Managing Partner of Browne, Bortz, and Coddington, Denver, Colorado. Professor Gilmore is Senior Research Fellow, University of Denver Research Institute, Denver, Colorado.

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At the present time, we are about midway through the EPRI sponsored research on impacts of power plants. This two-year project has several purposes. The major one is to develop a data base for estimating or anticipating the impacts of power plants. We are not trying to develop a new or better model. We are hoping to generate information which will make models work better. Ten or twelve retrospective case studies will trace the impacts of power plant construction after the peak construction period. The locations of the case study areas are shown in Figure 1. One case study has been completed and the remainder will be completed by spring and early summer of 1980.

KEY FACTORS OR VARIABLES USED IN MOST IMPACT ASSESSMENT MODELS

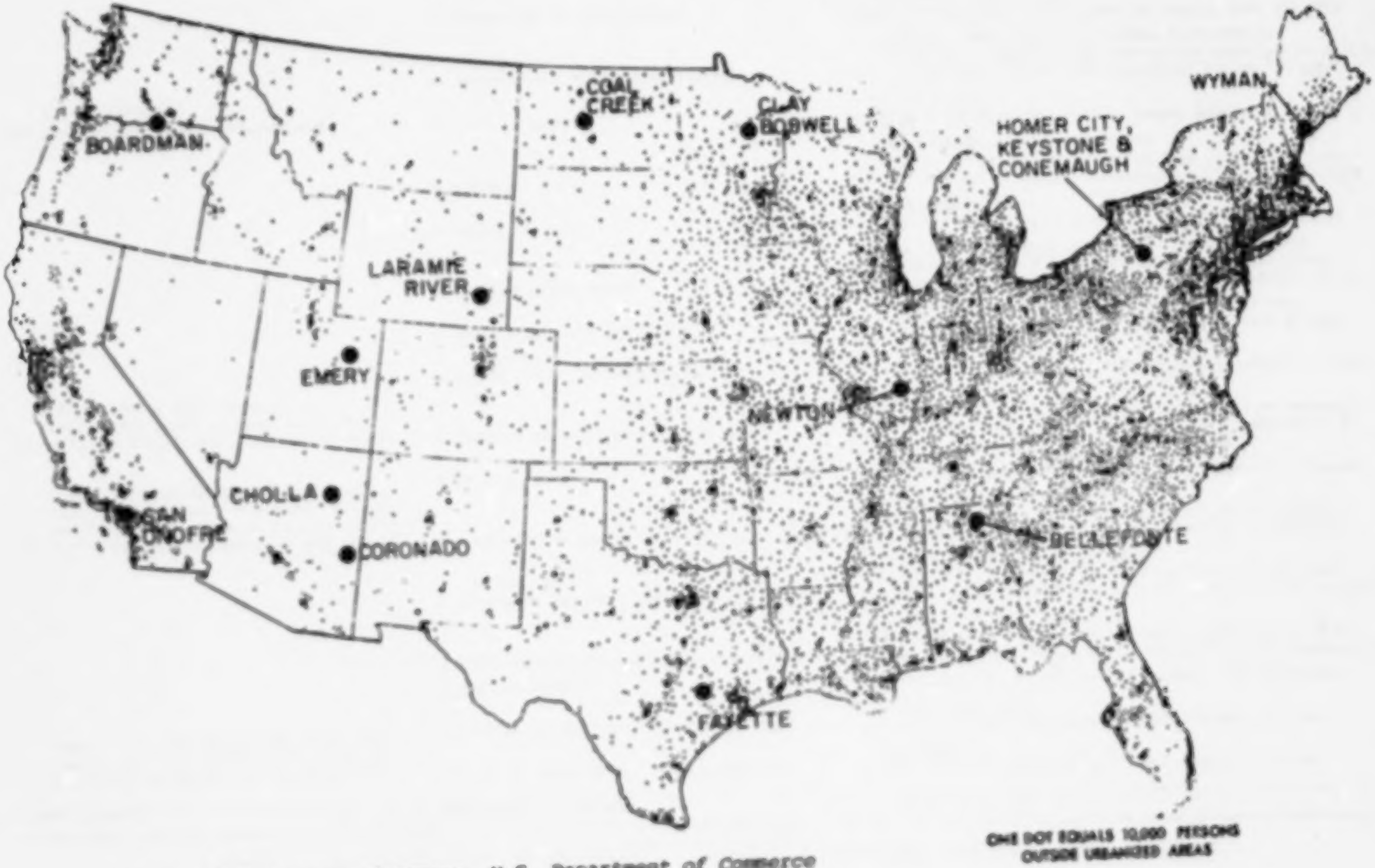
An early task in the EPRI project was to identify and review the various models used in socioeconomic impact assessments. The term "model" refers to an approach to simplifying and depicting reality in socioeconomic assessment. Most of the models reviewed and noted in the bibliography are mathematical representations of what is likely to happen when a major new economic factor, such as a power plant, is superimposed onto a local social and economic base. Other analytical approaches typically used in impact assessment are also considered to be models in the context of this research.

Impact assessment models were grouped into two broad categories: integrated impact assessment models and single element models. The integrated impact assessment models include those with which most of you are familiar (BREAM, SEAM, BOOM, CEQ, DRI, and others). Most of the integrated impact assessment models include the various elements in single element models.

Figure 2 compares the relationships among impact elements, approaches (or models) and data needs. Our emphasis in the EPRI project is on data needs. The impact elements being considered include geographic distribution of impacts, construction worker patterns and characteristics, employment and income multipliers, population, household and demographic projections, fiscal impacts, and housing supply and demand. Various approaches (models) for estimating each impact element are apparent and these relate to data needs. There are many data needs for improving the accuracy of the various elements of an integrated impact assessment model.

A number of phenomena or study factors are the focus of our case study research. We attempt to identify data, and analyze these data, for each of these factors. The phenomena fall into six broad categories as summarized in Figures 3-A through 3-F.

FIGURE 1. LOCATIONS OF CASE STUDY SITES



Source: U.S. Bureau of Census, U.S. Department of Commerce

FIGURE 2. RELATIONSHIPS AMONG IMPACT ELEMENTS, APPROACHES USED AND DATA NEEDS

Impact Elements	Approaches (or Models)	Data Needs/Comments
(1) Geographic distribution of impacts (definition of area of site influence; commuting areas; settlement patterns)	• Rules of thumb (e.g., 50 mile radius)	Better rules of thumb based on more studies of actual experience
	• Comparative analysis with similar areas	The EPRI and NRC Post Licensing study should be helpful; TVA has some data
	• Gravity models	Mileage/driving time to nearest cities; city populations
	• Labor force/commuting patterns analysis	Secondary data on labor force, unemployment and underemployment; survey may be needed to estimate availability of construction workers by skill
	• Judgmental approach based upon knowledge of the area	Location of housing and amenities (both private and public); knowledge of transportation network and driving times; local attitudes toward growth
(2) Causal factors (levels of direct employment; union vs. nonunion hiring; construction management practices; on-site assembly; local purchasing practices)	• Interviews or direct contact with builder	Some data available relating labor costs to megawatt of capacity being built; direct contact with architect/builder essential
	• Rules of thumb	Based upon published material and other secondary sources; this is not an adequate approach
(3) Baseline projections (employment; population/households; income; housing; public sector requirements)	• Economic base analysis (traditional)	Secondary sources (federal, state and local) augmented by interviews in study area; basis for projecting economic base without power plant
	• Static (assume present conditions will continue)	Data same as above, but not projections of "future without"
	• Regression/trend analysis	Historical data from secondary sources projected without in-depth understanding of economic forces at work
	• Modified input-output	Need current I-O tables that correspond (generally) to impact area. Lacking these data, estimate coefficients from latest available national or regional studies
	• Cohort survival	Secondary data are usually available (Census reports) to forecast population
	• Community survey	Survey data can be useful in baseline projections, particularly if latest Census is out of date (too old or significant change since last Census)
(4) Construction worker patterns and characteristics	• Rules of thumb	Usually based upon construction worker profile or other recent studies
	• Comparative analysis with similar situations	For impact areas having characteristics similar to those where data on construction workers are unavailable, useful approach; especially good in west or southeast
	• Detailed analysis of trades	Requires data from labor unions in general area and data from architect/builder

FIGURE 2. (CONTINUED)

Impact Elements	Approaches (or Models)	Data Needs/Comments
(4) Continued	• Labor market analysis	Survey of secondary data (state employment offices) may assist in identifying local resources; residual will be inmigrants to impact area
(5) Employment multipliers (construction and permanent workers; linked industry)	• Rules of thumb/judgmental approaches	Usually based upon past experience or upon study of local area (see economic base analysis above)
	• Simple industry classification system	County breakdown of employment by two digit SIC categories
	• Location quotient	Census and state employment data needed for analysis
	• Modified input-output	See comments above under (3) baseline projections
	• Analysis of local industry	Combines secondary data with more in-depth knowledge of industry characteristics in impact area; substantial field work required
	• Dynamic (vs. static) models	Sources same as above; researcher must decide whether to vary the ratios over time or use one ratio through estimating period
	• Comparative analysis	Need data on other capital intensive projects in roughly similar situations
(6) Income multipliers and impacts	• Rules of thumb/judgmental approaches	U.S. Department of Commerce income data by local areas is key data source; projections based upon past experience and knowledge of impact area
	• Community survey	Source of more current data on income patterns; would normally be combined with Commerce Department data
	• Modified input-output	See comments above
	• Comparative analysis	Sources include U.S. Department of Commerce data plus data on other similar areas that have experienced impacts
(7) Population, household and demographic projections (assuming power plant construction)	• Employment to population ratios	Construction, permanent and local employment and characteristics of each group; normally use construction worker survey data and secondary sources
- both incremental and total	• Worker to family size ratio	Based on current conditions in study area, comparisons from areas where survey data available, or by rules of thumb
	• Regression/trend analysis	Emphasis on analysis of past trends using secondary data (Census and state)
	• Cohort survival	Relies on Census data and other available secondary sources
	• Comparative analysis	Uses secondary sources plus data available from similar situations

FIGURE 2. (CONTINUED)

Impact Elements	Approaches (or Models)	Data Needs/Comments
(8) Retail, local service and other private sector impacts (including lag and accelerator effects)	• Income generation/allocation	Based upon (7) with judgmental allocation on how income spent both geographically and by type of service; secondary data available on national basis on expenditure patterns
	• Supply and demand analysis	Incorporates data generated in (7) with inventory of existing retail/service facilities; national data available on ratios of sales per square foot
	• Rules of thumb/judgmental approaches	Sometimes uses per capita approach and ratio analysis; secondary data from federal and state sources, and from community surveys (if available)
	• Comparative analysis	Relies upon experience elsewhere
(9) Public service and facility requirements	• Expectations of local officials	Local interviews; review of local planning documents
	• Ratio analysis (comparisons with accepted standards)	National data available for a number of factors; local data needs to be generated from interviews and local sources
	• Rules of thumb/judgmental approaches	Based upon prior experience; considers experience of other public entities
	• Comparative analysis	Heavy reliance on experiences and data generated in similar type impact areas; primarily used in west and southeast
(10) Fiscal impact analysis (estimates of tax base; other revenue sources; operating costs; capital facility requirements; overall financial condition)	• Computerized models based upon analysis of local conditions	Relies on local cost and analysis of cost trends; projections based on combination of past trends and national standards; computer-assisted projections on year-by-year basis
	• Analysis of local budgets with inputs from local officials	Similar to above, but without national data or computer analysis
	• Rules of thumb/judgmental approaches	Based upon broader categorization of revenue and cost groups; relies on experience of analyst
(11) Housing supply and demand analysis	• Community survey	Survey of housing characteristics and anticipated needs
	• Contacts with local experts combined with comparative and judgmental approaches	Relies on secondary data on housing supply situation combined with analysis of future demand and community's ability to provide new housing; results of analysis reviewed by knowledgeable local persons
	• Housing patterns of workers at other projects	Relies on construction worker data and experience in other impacted areas in same region
(12) Other (insurance rate impacts, traffic effects, etc.)	• Community survey	Data needs to relate to specific factor being studied
	• Judgmental approaches	
	• Comparative analysis	

FIGURE 3-A. IDENTIFICATION OF PHENOMENA TO BE STUDIED IN PHASE II, DESCRIPTION OF SOURCE OF IMPACTS

	Major Phenomena to be Studied	Secondary Phenomena to be Studied	Comments
A-1	Number of construction workers in relationship to plant capacity (megawatts).		Data needed by quarter and annually for the duration of the construction period. Should consider both peak and total man year requirements.
A-2	Number of construction workers by major skill categories in relationship to plant type and capacity.		Electricians, plumbers, sheet metal workers, carpenters, etc. Need to consider labor union jurisdictional boundaries.
A-3	Absentee rates and impact on total construction work force.		These rates can run as high as 15 percent, and may influence number of workers in the impact area.
A-4	Comparisons of projected vs. actual construction work force.		Experience has shown that this is a major problem for communities trying to anticipate impacts.
A-5	Characteristics of construction work force relative to type of plant and management approach.		Factors related to this are union vs. non-union, scheduling of project, and use of subcontractors.
A-6	Capital investment (by year) and rate it goes on tax rolls.		Needed to better estimate tax base effects.
		• Extent of linkage with other industries.	Where linkages exist, need basis for estimating.
		• Variations in local purchasing practices during construction.	Assumptions need to be made relative to local purchases; represents basic economic activity.
		• Quality of construction work force related to competition for construction labor.	May affect worker productivity and plant costs.
A-7	Sources of uncertainty--both causal factors for builders and factors influencing community response.		A difficult, but very important factor to analyze.

FIGURE 3-B. IDENTIFICATION OF PHENOMENA TO BE STUDIED IN PHASE II GEOGRAPHIC EXTENT OF IMPACTS

	Major Phenomena to be Studied	Secondary Phenomena to be Studied	Comments
B-1	Relationship between local labor force and in-migration of construction workers.		A critical issue in more urbanized impact areas.
B-2	Factors influencing extent of commuting.		Transportation network, availability of housing, construction management practices, etc.
B-3	Factors influencing worker selection of communities as a place to live within impact area.	Ability of communities to influence worker settlement patterns.	Important part of analysis, particularly as it relates to public requirements and fiscal impacts.
		Ability of plant builder/owner to influence geographic distribution of impacts.	Relates to degree of success in growth management planning.
		Degree to which locally hired workers affect the economy of the impact area.	

FIGURE 3-C. IDENTIFICATION OF PHENOMENA TO BE STUDIED IN PHASE II BASELINE CONDITIONS (PRESENT AND PROJECTED)

	Major Phenomena to be Studied	Secondary Phenomena to be Studied	Comments
C-1	Nature of employment and income multipliers over time.		
C-2	Population to labor force and employment ratios over time.		
C-3	Effects of other basic industry new to an area.		Relates to areas experiencing multiple impacts from other types of industrial development.
		Usefulness of cohort survival method of projecting baseline population.	Is it worth the trouble to use this approach in areas being impacted? Under what circumstances?

FIGURE 3-D. IDENTIFICATION OF PHENOMENA TO BE STUDIED IN PHASE II, SECONDARY ECONOMIC IMPACTS

	Major Phenomena to be Studied	Secondary Phenomena to be Studied	Comments
D-1	Employment multipliers for construction workers.	• Employment multipliers for permanent employees.	This is an area where most researchers "guess," or use rules of thumb; static vs. dynamic multipliers will be considered.
D-2	Relationship between plant construction and availability of retail and service activities in host communities.	• Capital availability for local investment.	A critical issue in sparsely populated impact areas.
D-3	Magnitude of lag effect.	• Magnitude of accelerator effect.	What causes these effects to occur? Effect of local planning?
D-4	Employment to population ratio resulting from impacts.	• Changes in average family size.	
D-5	Employment and income relationships.	• Incidence of ripple effect when people move up to higher paying jobs.	How much difference does it make to account for income differentials in estimating impacts?
		• Effects of wage/income differentials on employment multipliers and secondary impacts.	
D-6	Relationship between school enrollment and population change.		Key variable influencing public school capital and operating costs.
		• Magnitude of secondary impacts in declining, stable, growing and booming areas.	
		• Effect of power plant construction on unemployment/underemployment in impact areas.	Does a major construction project make much difference relative to unemployment/underemployment?
D-7	Measures of adequacy of private sector response.		
		• Effects of power plant construction and operation on per capita income.	

FIGURE 3-E. IDENTIFICATION OF PHENOMENA TO BE STUDIED IN PHASE II HOUSING IMPACTS

	Major Phenomena to be Studied	Secondary Phenomena to be Studied	Comments
E-1	Housing demand as a function of construction worker preferences and characteristics.	Differences between preferences and actions.	How much weight can be given to construction worker preferences on housing?
		Effect of income patterns on effective demand.	
E-2	Elements of a responsive housing supply market (financing, utilities, land, entrepreneurship).	Power plant economic life as it relates to mortgage financing.	Very little is known about how housing markets function in impacted areas, particularly where substantial quantities of housing are needed.
		Degree to which housing problems can be mitigated by federal, state or industry housing programs.	Do these programs really make a difference?
E-3	Relationship between housing supply and demand in impact area.	Relationship between housing needed for construction workers vs. that required for permanent (and induced) workers.	
		Effect of power plant on housing costs and prices.	This partially relates to the demand for construction workers and wages paid.

FIGURE 3-F. IDENTIFICATION OF PHENOMENA TO BE STUDIED IN PHASE II, PUBLIC SECTOR IMPACTS

	Major Phenomena to be Studied	Secondary Phenomena to be Studied	Comments
F-1	Effect of growth on community preferences, needs and standards (services and facilities).		It is difficult in estimating public sector needs and costs to account for possible changes in preferences or accepted standards of service.
F-2	Relationship between power plant construction schedule and additions to local tax revenues.		This includes all types of revenues including property taxes from plant.
		• Factors influencing both revenue and operating cost estimates.	
F-3	Degree to which local governments have dealt with financial aspects of power plant construction.	• Factors influencing willingness of local government to finance expansion through debt financing.	
		• Lag time for local government to respond to impacts.	
		• Effect of power plant on long-term per capita tax revenues.	
		• Effect of previous planning efforts on ability of public entities to respond to change.	To what extent has local planning paid off?
F-4	Relationship between school enrollment and classroom needs.		Estimation of school enrollment mentioned in Exhibit E, secondary economic impacts.
F-5	Relationship between jurisdictions receiving tax base increases and those servicing growth induced by plant construction.		These "jurisdictional mismatches" can be extremely important.

(1) Description of source of impacts.
(2) Geographic extent of impacts.
(3) Baseline conditions (present and projected).
(4) Secondary economic impacts.
(5) Housing impacts.
(6) Public sector impacts.

SOME PRELIMINARY STUDY FINDINGS

Several general findings should be of interest although the orientation of the EPRI study is the development of a data base. We emphasize again that these findings are based on limited field research to date. The extensive literature search is much broader than just the identification of impact assessment models, and we have attempted to compare projected impacts against those which actually occurred in a number of instances.

Actual Versus Projected Construction Employment

Any impact assessment model is only as good as the key data going into it, and the accuracy of construction work force projections are most important. In a number of locations, the original employment projections were considerably lower than the actual construction work force on site at the relevant time. Actual employment has been in excess of 200 percent of the original projections in several instances.

Startup date slippage due to problems in obtaining regulatory permits or front-end financing has been a major cause of changes in employment projections. Overstaffing to put the project back on schedule has often resulted. Original projections made by engineering firms in some cases have been overly optimistic in estimating the number of manhours required to complete a job without regard for slippage or loss of productivity. Strikes necessitated construction employment revisions in other cases. In one instance a court injunction caused delays in the construction schedule.

Every single case study had projected a construction work force which was outside a range of 30 percent plus or minus of that actually occurring on a year by year basis. The difficulties and uncertainties of projecting power plant construction schedules are serious. We suggest that a number of scenarios be included to make the impact assessment modeling more worthwhile.

Definition of Impact Area

The area impacted tends to be significantly larger or smaller than that originally estimated. Analysts tend to underestimate the extent of commuting to a construction site and therefore underestimate the geographic extent of impacts. This type of error leads to an overestimation of local area impacts.

A greater proportion of workers than originally anticipated in the studies reviewed have chosen to reside in nearby urban areas. Similarly, a greater proportion of workers than expected at many power plants have commuted on a weekly basis. These divergencies from projected commuting patterns have led to overestimations of impacts on schools and other local government services in localities with construction projects.

Role of Labor Unions

The structure of local labor unions in a given region relates to the geographic spread of construction workers. We have been more impressed by the importance of labor union jurisdictions and related hiring practices than any of the various factors we have examined to date. If we are faced with the task of estimating the area to be impacted for a power plant, one of the first tasks is to understand the labor union hiring by talking to labor union officials about how plant manpower requirements will likely be met.

Shifting Mix of Workers by Skilled Categories

The shifting mix of skills required to build a large power plant is related to the area of site influence and importance of labor union patterns. Figure 4 shows the percentage of workers in various skill categories needed to construct the Coal Creek Station in North Dakota. The number of laborers represented 23 percent of the work force in the initial quarter of construction but this dropped steadily throughout the project. The same pattern is true for carpenters. On the other hand, boilermakers, electricians and pipefitters all increased in relative importance as the project progressed. Labor union locals of each of these groups may be located in different areas and draw workers from significantly different jurisdictions. Recognition of these shifting patterns is important in estimating local area impacts.

Tendency to Overestimate Impacts

The impact of construction workers on a local area economy tends to be overestimated even where accurate estimates have been made of the level of the construction work force and the number of workers likely to reside in close proximity to the plant. The number of local service jobs created by construction workers appears to be very small. There are other factors which tend to inhibit the response of the local economy to a large surge of new construction employment. These factors are well recognized. We are again impressed in our research so far, with the fact that secondary impacts tend to be very small and are often overestimated. These comments relate to construction workers and are not thought to be representative of the impact of permanent workers.

FIGURE 4. CONTRACTOR LABOR FORCE, COAL CREEK STATION, BY CRAFT, BY QUARTER, JUNE 1975-JUNE 1979 (PERCENT)

Craft	1975		1976				1977				1978				1979	
	Third	Fourth	First	Second	Third	Fourth	First	Second	Third	Fourth	First	Second	Third	Fourth	First	Second
Boilermakers	0	5	0	2	3	8	14	14	14	15	16	14	12	11	10	9
Bricklayers	0	0	0	0	1	1	4	2	1	1	0	1	1	0	0	0
Carpenters	10	6	7	9	12	12	15	10	8	6	7	7	6	3	4	5
Cement Finishers	1	3	2	2	3	1	2	2	1	1	1	1	1	0	1	0
Electricians	5	9	7	5	4	6	4	10	14	18	16	17	21	27	26	26
Ironworkers	6	9	36	24	30	24	9	17	14	10	10	9	7	5	4	4
Laborers	23	8	16	18	14	14	13	12	10	8	7	9	8	7	7	8
Millwrights	0	0	0	0	0	0	0	2	2	3	2	3	2	3	3	3
Operators	33	32	13	25	14	9	10	8	9	8	7	7	6	4	3	3
Painters	0	0	0	0	0	0	0	1	1	1	0	1	2	2	2	2
Pipefitters	7	3	7	3	4	9	9	8	13	17	18	17	20	20	23	21
Sheet Metal	0	3	0	0	7	7	10	4	3	3	3	4	4	5	5	6
Insulators	0	0	0	0	0	0	0	0	0	2	3	3	3	3	4	4
Teamsters	3	4	2	2	1	3	2	1	1	1	0	0	1	1	0	0
Supervision	11	17	11	9	7	6	7	8	8	8	8	7	7	8	9	9
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Note: Totals may not add to 100 percent due to rounding. Percentages are for plant construction workers only.

Source: Special periodic tabulations (usually monthly) by UPA.

Most Impacts are Perceived as Positive

Most of the areas where we have conducted retrospective case studies do not appear to have suffered from a significant number of negative impacts, with very few exceptions. Businessmen, public officials, and others we have interviewed tend to be positive on the impacts which have occurred as a result of the construction of a power plant in their community or area. This is probably related to the fact that most of the impacts have not been as great as originally anticipated and therefore the potential negative effects resulting from sudden and very significant population and economic growth have not occurred to the degree expected. Furthermore, a retrospective examination is affected by the likelihood that the "losers" have left the area and the "winners" have stayed. There is a danger of generalizing too much from the experience of power plant construction in Rock Springs. That appears to be an extreme case and is not necessarily representative of what we have seen in other parts of the Rocky Mountain region and the rest of the United States.

A BROADER PERSPECTIVE

There is increasing interest and concern over "impact management." Impact management, as we use the term, has a broader meaning than "impact mitigation" or "impact alleviation." We see an increasing awareness by industry of the fact that positive and negative impacts are likely to occur when a major new project is built and thus a willingness to attempt to manage these impacts. The permitting process in most states is a powerful factor motivating industry management to be concerned about impacts. The potential negative effect of poor socioeconomic conditions on construction worker productivity is extremely important and usually recognized by company management. A very small drop in labor productivity can increase the cost of a power plant by tens of millions of dollars. The cost of having an impact management program when compared with labor productivity effects is not large.

The increasing importance of impact management does not mean that anticipatory impact assessment is less important. It is increasingly obvious that the impact assessment which considers only one alternative or scenario is not adequate. Any institution or individuals concerned with impact management must be aware of the consequences of a number of different alternatives. What is the effect of a one year delay in the commencement of construction? What would be the impact of peak employment leveling at 1,000 instead of 1,500? How can industry influence commuting and housing patterns?

The implications of all of this for those interested in impact assessment appear to be clear. The computerized integrated impact assessment model will have an increasing role because of its ability to deal with a number of different scenarios or alternatives. However, these models must be kept relatively simple and flexible so that company management feels comfortable in using them. There is also concern over the cost of operating the model. Even more important, the time available to prepare estimates is usually in the three to six month time period. Potential users of integrated models would expect them to be responsive within that time frame.

ECONOMIC-DEMOGRAPHIC ASSESSMENT MODELS: A DISCUSSION OF CRITERIA FOR SELECTION AND A COMPARISON OF SELECTED MODELS

Steve H. Murdock
F. Larry Leistritz 1/

INTRODUCTION

The economic, demographic, and social effects of large scale industrial and resource development projects are a growing concern to managers and decisionmakers in both private and public sectors. The rapid population growth and associated public service and social problems resulting from energy resource development in rural areas of the western United States have demonstrated the need for more effective means of predicting and mitigating impacts (Albrecht, 1978; Gilmore, 1976).

Lack of accurate and timely impact projections and effective growth management plans lead to serious problems. Unmanaged growth may lead to costly delays of major projects (Gilmore, 1976) and result in secondary environmental effects in the areas of water quality, air quality and land use (White, et al., 1978). Recent legal developments indicate that governmental agencies responsible for licensing and assessing the environmental impacts of major energy development installations will be required to include economic and social impacts in their assessments and that developers have a responsibility to mitigate adverse socioeconomic impacts (Watson, 1977). Both the utility and necessity of obtaining such information is thus apparent.

A major problem is how to get accurate and timely estimates of socioeconomic impacts. Impact assessment processes have become

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thoroughly institutionalized, but much of the information produced is of limited utility. It fails to be applicable to local planning needs and tends to be quickly outdated due to the rapid changes characteristic of energy developments (Auger, *et al.*, 1976). The need for a mechanism that provides timely and flexible projections of a variety of social and economic indicators is apparent.

A number of computerized socioeconomic impact assessment models have been developed in response to this demand (Cluett, *et al.*, 1977; Ford, 1976; Hertsgaard, *et al.*, 1978; Mountain West Research, 1978; Reeve, *et al.*, 1976; Stenehjem, 1978), and voluminous literature describes impact assessment methodologies (Abt Associates, 1975; Chalmers and Anderson, 1977). These models provide a wide range of outputs and do so in a flexible and timely manner. Models, however, differ widely in input structures, computational procedures, outputs, and in many other regards.

The criteria that should be used in choosing a model and the advantages of each under different circumstances are difficult to discern. The result is that decisionmakers avoid using such models despite obvious advantages.

The purpose of this discussion is to identify criteria to evaluate models and to apply these criteria to a wide range of current socioeconomic assessment models.

CRITERIA FOR EVALUATION

The needs of clients and the criteria for evaluating models are likely to vary greatly, but several model characteristics should be common regardless of the background circumstances. Criteria should include:

1. Information requirements.
2. Methodological forms and validation.
3. Use characteristics.

Informational Requirements

The decision needs of the user is the starting point in selecting a model -- what information is needed, for what area, and for what periods of time. Environmental impact assessments demand an increasingly large volume of socioeconomic data. These data usually include, at a minimum, information on the economic, demographic, public service, fiscal, and social changes likely to occur under both baseline and impact conditions for both construction and operational phases (Council on Environmental Quality, 1978).

The economic data usually preferred by users includes income, employment, business activity, and industry mix. Demographic information usually includes population, age, ethnic, and other data groups for small geographic units as well as the total area impacted. Public service data concentrate on new service facilities and personnel required to serve inmigrating populations. Fiscal analyses focus on the costs of services and the public revenues likely to ge generated. Social changes are measured by the population's perceptions of development, goals for the communities, community satisfaction, and social structures. The acquisition of each of these potential data sets requires extensive time and resource expenditures, and their inclusion in a model is a significant consideration. Those models that provide larger proportions of the necessary data items are of greater utility. 2/

Equally important is the geographic detail. Many models provide output only at an aggregate impact level or for counties, but not for individual cities or other government districts. Such models are of little utility for assessing local government impacts.

Models should provide results for the necessary time periods. Impact periods, particularly construction phases, often show rapid changes from year to year and these changes require careful planning and resource allocation. Models providing results for only five year periods will not detect year to year changes.

Finally, it is essential that the model provide separate outputs for baseline and for construction and operational impact periods. Impact assessment is a comparison of conditions under impact and baseline conditions. Construction and operational phases are separate parts of impact assessments so that separate results for each impact phase are essential. In sum, the temporal as well as geographical specificity of model outputs should be considered.

2/ Models which address a larger number of impact categories and provide projections in a more disaggregated form can address a broader range of user needs. Such models, however, impose greater costs for data collection and updating, and estimation of the relationships embodied in them can become statistically complex. Trade-offs are thus inherent in designing impact models.

Methodological Considerations

Several aspects of model methodology enter into evaluations of alternative models. First, some methodologies are generally more adequate than others in terms of the utility and range of information they provide. Although, under any set of circumstances, several alternative methodologies may be of equal utility, general assumptions can be made in regard to such methodologies. For example, techniques using age cohorts provide more detailed planning information (Shyrock and Siegel, 1973), and input-output models provide a wealth of detail. The user must, however, evaluate if predictive accuracy is sacrificed for detail -- the problem of validation.

Secondly, submodule integration is important. Some models carefully integrate the economic and demographic parts. Others merely apply separate methodologies to a common situation.

Finally, the assumptions underlying the methodologies employed in such models must be evaluated in terms of the dynamic capabilities of the model including:

1. The capability to incorporate changing relationships among factors over time;
2. Whether key structural dimensions of the dynamic phenomena are incorporated; and
3. Whether feedback loops update the computational bases.

In general, models that allow the use of multiple rates for various factors during different phases of the projection period (such as changes in labor force participation rates or fertility rates), that utilize factors that most closely differentiate between key dimensions (such as industries or age cohorts), and that incorporate procedures that feedback changes (such as alterations of population age structures or changes in the economic structures), can be more dynamic than others.

An overriding factor in model selection must be a model's accuracy in predicting impact and baseline conditions into future periods. Most models are recent and have accumulated little evidence of their validity. Some models, however, have been validated to a limited extent. Several types of validity tests can be made quite easily, given samples of model outputs. Estimates of income and employment at the county level and population levels for counties and incorporated areas are published periodically by the Bureau of Economic Analysis and the Bureau of the Census. These estimates, compared with those from models, provide a partial evaluation of accuracy. Such comparison of data from past periods to those projected by a model is termed historical simulation

(Pindyck and Rubinfeld, 1976). In addition, dynamic simulation techniques and sensitivity analysis (Pindyck and Rubinfeld, 1976) can be used to analyze such models. This involves a comparison of the trends shown in the model output for the projected future periods to those noted in impacted areas in the past. Such analyses provide a valuable and clearly essential step in model analysis and model selection.

Use Characteristics

An important use characteristic is the availability and cost of input data for a model. Models that reduce data collection costs by utilizing national data bases may accentuate problems in projecting local level conditions that depart markedly from national patterns. The trade-off between the need for locally oriented data inputs and the costs of collecting local data must be carefully evaluated.

The flexibility of use of the model should also be considered. Impact assessments and impact events involve numerous factors that are difficult to predict. A range of potential impacts under widely varying assumptions could be experienced. Models that provide easy alterations of input factors and rapid outputs for alternative development scenarios are often desirable. Model options for altering key assumptions such as the number of projects, the size of the project, the location of the project, inflation rates, birth rates, per capita service usage rates and other factors may be particularly crucial.

Yet an additional criterion is the availability and adaptability of the computerized form of such models. Some models can be accessed only through the agency that implemented the model while in other cases cooperative agreements can be established which provide the model code to a user agency. In general, efficient use of the model is facilitated by the ability to acquire the model code.

Assurance of availability of appropriate computer facilities and computer compilers is essential if the computer code is to be obtained. Incompatability of different types of hardware and the lack of appropriate language compilers can make adaptation very costly.

MODEL COMPARISON

A comparison of a wide set of models presently employed in socioeconomic impact projects can be made in terms of the criteria noted above. The models evaluated include:

1. ATOM 3 (Beckhelm, et al., 1975).
2. BOOM 1 (Ford, 1976).

3. BREAM (Mountain West Research, 1978).
4. CLIPS (Monts and Bareiss, 1979).
5. CPEIO (Monarchi and Taylor, 1977).
6. HARC (Cluett _et_ _al_., 1977).
7. MULTIREGION (Olsen _et_ _al_., 1977).
8. NAVAHO (Reeve _et_ _al_., 1976).
9. NEW MEXICO (Brown and Zink, 1977).
10. RED-II (Hertsgaard _et_ _al_., 1978; Leistritz _et_ _al_., 1979).
11. SEAM (Stenehjem, 1978).
12. SIMPACT (Huston, 1979).
13. WEST (Denver Research Institute, 1979a).

These models include a majority of those which project the impacts of large-scale resource developments, have published descriptions, and have been widely used by national, regional, and local decisionmakers (Denver Research Institute, 1979a; Markusen, 1978).

The comparison of these models is presented in three tables. Table 1 addresses Criterion 1 and describes the informational characteristics of the models. Discussed are the dimensions of the model, the project phases, the geographic unit, and the time periods for which projections are made. Dimensions considered as possible in such models are the economic, demographic, interface, distributional, public service, fiscal, and social components.

Table 2 compares the methodological characteristics of the models. These include the methodology used in each of several major components, the form of integration, the dynamic capabilities of each component, and the validation of each model. Characteristics for the economic, demographic, interface, distributional, service, and fiscal components of each model are described.

Table 3 addresses Criterion 3 on use characteristics. It compares the data inputs and the computerization requirements of each model, the extent to which users can alter parameters, and the possibility of interactive programming.

Information provided in available reports for each model limits the comparisons. Where such reports do not discuss a particular item, the designation INP (information not provided) is used. Users should conduct careful analyses of models that appear appropriate for their particular informational needs, given the limited information available. A brief description of the items in Tables 1-3 indicates how diverse are the capabilities and characteristics of the models.

Only four models (BOOM 1, RED-II, SIMPACT, and SEAM) contain as many as five dimensions (Table 1). None address social factors, and

TABLE 1. INFORMATIONAL CHARACTERISTICS OF SELECTED SOCIOECONOMIC IMPACT ASSESSMENT MODELS

Model	Dimensions Included							Project Phases Analyzed			Geographic Areas Included	Time Increments and Total Projection Periods	Total Number of Areal Units
	Economic	Demographic	Interface	Distribution	Public Services	Fiscal	Social	Baseline	Construction	Operational			
ATOM-3	X	X^1	X					X	X	X	State and County	Yearly; NLS	14 counties in Arizona
BOOM-1	X	X	X		X	X^2		X	X	X	City only	Yearly; NLS	any given city
BREAM	X	X	X	X				X	X	X	Region, County, Cities	Yearly; NLS	2 counties maximum
CLIPS	X	X	X	X		X^3		X	X	X	Region, County, Cities	Yearly; 20 years	INP
CPEIO	X	X	X		X^4			X	X	X	Restricted to one area, any level	Yearly OAD; NLS	one areal unit
HARC	X	X^1	X	X	X			X	X	X	Project and County	Five Year; 30 years	INP
MULTIREGION	X	X	X	X				X	X	X	BEA Regional	Five Year; NLS	ALL BEA Regions

TABLE 1. (CONTINUED)

NAVAHO	X	X	X	X			X	X	X	Reservation Districts	Five Year; NLS	9 Reservation Districts
NEW MEXICO	X	X	X				X	X	X	State Planning Regions	Five Year; 20 years	7 State Planning Regions
RED	X	X	X	X	X	X	X	X	X	State, Region, County, Cities	Yearly-OAD; 25 years	8 Regions, 53 cos., 350 cities
SEAM	X	X	X	X	X	X[3]	X	X	X	County, Cities	Yearly; 30 years	INP
SIMPACT	X	X	X	X	X	X	X	X	X	Region, County, Cities	Yearly; construction, 10 years operation	Region and 11 subareas
WEST	X	X		X	X[4]	X	X	X	X	Region, County, Cities	Yearly; NLS	INP

Abbreviations for Items

NLS = No Limit Specified
OAD = Or As Desired
INP = Information Not Provided

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[1] Demographic Model includes special population submodules
[2] Costs are aggregated
[3] Revenues are not calculated
[4] Only two services projected

TABLE 2. USE CHARACTERISTICS OF SELECTED SOCIOECONOMIC IMPACT ASSESSMENT MODELS

	Input Data Requirements			Flexibility		Computerization	
Model	Source	Geographical Level	Form	User-Alterable Parameters	Degree of user Interactivity	Model Language	Transferability
ATOM-3	State and Local	State and County	Primary I-O other Secondary	None	None	FORTRAN	Other Models closely related (BREAM)
BOOM-1	State and Local	County and City	Secondary, Judgmental	None	None	GASP IV	Yes-Texas
BREAM	State and Local	Region and County	All Secondary	None	None	FORTRAN	Untested
CLIPS	State, Local Western U.S.	Region, County, City	All Secondary	SD,PC INP	Interactive	FORTRAN	Untested
CPEIO	State and Local	The given level of analysis	Primary I-O other Secondary	SD,PC AE, UNEMP. Output	Interactive (Knowledgable User)	SIMSCRIPT	Untested
HARC	National, State and Western U.S. Judgmental	County	All Secondary	None	None	INP	Untested
MULTIREGION	National and Regional	National and Regional	All Secondary	None	None	FORTRAN	Untested

TABLE 2. (CONTINUED)

NAVAHO	National and Reservation	Reservation & District	All Secondary	None	None	FORTRAN	Untested
NEW MEXICO	State and Regional	State, Region County	Primary I-O other Secondary	None	None	INP	Untested
RED	State, Region, Local	State, Region, Local	Primary I-O Primary Labor Force Other Secondary	SD,PC BR,IR TR,GM Output	Interactive	APL	Yes-Texas
SEAM	National & Regional	National & Regional	All Secondary	SD, PC Impact Area	Interactive	INP	Untested
SIMPACT	Regional, State and Local	Region County and Local	INP	INP	Interactive	FORTRAN	Untested
WEST	State and Local	State and Local	All Secondary	None	None	FORTRAN	Untested

SD = Starting Date
PC = Project Characteristics
AE = Available Employment
UNEMP. = Unemployment Rate
OUTPUT = Type or form of Output
BR = Birth Rate

IR = Inflation Rate
TR = Tax Rate
GM = Gravity Model Coefficients
IMPACT AREA = Selection of Impact Area
INP = Information Not Provided

TABLE 3. METHODOLOGICAL CHARACTERISTICS OF SELECTED SOCIOECONOMIC IMPACT ASSESSMENT MODELS

	Methodological and Integrative Forms by Component						Dynamic Capabilities by Component						
Model	Econ	Dem	Interface	Subarea Distribution	Service	Fiscal	Econ	Dem	Interface	Subarea Dist.	Ser	Fis	Validation
ATOM-3	I-O	CC-S	E-M-1	Share	NA	NA	Yes	Yes	Yes	Yes	NA	NA	Historical
BOOM-1	E-B	E-P	E-P-1	NA	P-B	Per Capita	Yes	Yes	Yes	NA	NA	NA	Sensitivity
BREAM	E-B	CC-S	E-M-1	Share and Gravity	P-B	NA	Yes	Yes	Yes	Yes	NA	NA	INP
CLIPS	E-B	CC-S[1]	E-M-1	Share and Gravity	NA	Per Capita	Yes	Yes	Yes	Yes	NA	Yes	INP
CPEIO	I-O	CC-S	E-M-1	NA	NA	NA	Yes	Yes	Yes	NA	NA	NA	Some, Forms Unspecified
HARC	E-B	CC-S	E-M-1	Gravity	P-B	NA	Yes	Yes	Yes	Yes	Yes	NA	Sensitivity
MULTIREGION	E-B	CC-S	E-M-1	NA	NA	NA	Yes	Yes	Yes	NA	NA	NA	Historical
NAVAHO	E-B	CC-S	E-M-M	Gravity	NA	NA	Yes	Yes	Yes	Yes	NA	NA	INP
NEW MEXICO	I-O	CC-S	E-M-M	NA	NA	NA	Yes	Yes	Yes	NA	NA	NA	INP

TABLE 3. (CONTINUED)

RED	I-O	CC-S	E-M-M	% Share and Gravity	P-B	Per Capita	Yes	Yes	Yes	Yes	Yes Yes	Sensitivity/ Historical
SEAM	E-B	CC-S	E-M-M	LP	P-B	Per Capita Facility	Yes	Yes	Yes	Yes	Yes Yes	Sensitivity/ Historical
SIMPACT	I-O	E-P	E-P-1	% Share	P-B	Per Capita Facility	Yes	Yes	Yes	Yes	Yes Yes	INP
WEST	E-B	E-P	E-P-1	% Share	P-B	Per Capita	Yes	Yes	No	Yes	Yes Yes	Sensitivity

Abbreviations for Items

Econ
I-O = Input-Output
E-B = Export Base

DEM

CC-S = Cohort Component Survival
E-P = Employment - Population Ratio

Interface
E-M-1 = Employment - Migrations - One phase
E-P-1 = Employment - Population - One phase
E-M-M = Employment - Migration - Multiphase Procedure

INP = Information Not Provided
NA = Not Applicable

Subarea Distribution
% Share = Distribution to subareas on bases of Employment or Population ratio
Gravity = Gravity Allocation Model
LP = Linear Programming Model

Service
P-B Population Based Projections

Fiscal
Per Capita = Per Capita Costs and Revenues
Facility = Projections of facility requirements also completed

[1] Cohort Component Survival Method used at Regional level only.

few contain the potential for such an expansion. All cover all three vital project phases, but areal coverage varies widely. Only six models analyze both county and city impacts. Most do provide yearly outputs but many are limited in the total number of units that can be included in the model.

The differences in methodological characteristics are less pronounced. Only five systems use an input-output method, and only three do not use a cohort-component demographic projection technique. Almost all use an interface procedure that involves the matching of available and required employment to determine migration levels. Nearly all are dynamically programmed. None have received adequate validation, but some have been subjected to sensitivity and historical simulation analyses.

The use characteristics (Table 3) again show great diversity from one model to another. The RED-II model requires the greatest amount of primary data while the SEAM model requires virtually no local data (except for the interface procedure where local data are necessary for nonwestern areas). All other models tend to be intermediate between these two in data requirements. Only five of the models are interactive (allowing users to alter various parameters) and, of these, the RED-II model appears to allow the alteration of more parameters than other models. Nearly all of the models are programmed in languages likely to be available at major computer installations. On the other hand, at small and medium size installations, compilers for some of the interactive languages (such as GASP IV, SIMSCRIPT, and APL) may not be readily available. Finally, in almost all cases, the adapatability of such models is untested. Although several models (including BREAM) incorporate aspects of the ATOM 3 model, and the BOOM 1 and the RED-II models are presently being adapted by various groups in Texas, the adaptability and transferability of such models remain largely untested.

Overall, then, the comparisons in Tables 1-3 suggest that available socioeconomic assessment models are not greatly different in the methodologies employed but are substantially different in the information provided and in use characteristics. Since these latter two factors are central to decisionmakers' concerns, careful evaluation of individual models is an essential first step in model selection.

SUMMARY AND CONCLUSION

An increasing demand for environmental impact assessments has heightened the development and use of computerized socioeconomic assessment models. Several considerations relate to that use.

First, such models cannot address many of the issues relevant in environmental decisionmaking. Questions related to social and environmental quality questions presently are not included. These models provide a large part, but not all of the data requirements necessary for a complete socioeconomic impact assessment.

Second, the methodology employed in such models requires extensive and continued development. The unknown validity of most such models requires careful attention. The similarities in the modeling methodologies employed may indicate that the enthusiasm and the need for such models have led to the development of similarly configured models before their usefulness has been adequately assessed. One of the major tasks of model developers in the early 1980's should be the assessment of the validity of their models in comparison to the data provided by the 1980 census. Until such assessments are made, the unanimity of methodologies may simply indicate how little is known about socioeconomic impacts. In addition, more attempts to adapt such models to other settings are essential.

Finally, the results suggest that, if properly selected, such models can meet a wide range of data needs, and that such selection can be done with only limited technical expertise. Data such as those in Tables 1-3 make it possible to select either a model that assesses a wide number of dimensions or one that provides only basic economic and demographic outputs. The user, given that choice, can select models that provide the geographical unit, time period, and areal unit coverage desired. Except for selected models, methodological considerations can largely be left to a second and more intensive level of selection. The user can then additionally select models on the basis of ease of use, sensitivity to local conditions, degree of user interactivity, and likely adaptability to available computer systems. In sum, the results suggest that a decisionmaker can select an appropriate socioeconomic assessment model with only limited technical assistance, and that many of the dimensions of such selection are those significant to decisionmakers. The analysis here suggests that computerized socioeconomic assessment models may provide a valuable tool for use in the decisionmaking process if the selection is done with care.

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RECENT STRUCTURAL CHANGES
IN NONMETROPOLITAN ECONOMIES:
MODELING IMPLICATIONS

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INTRODUCTION

The recent turnaround in rural-urban migration has stimulated much discussion in the literature of the past several years (Beale, 1975; Vining and Kontuly, 1978; and Schwarzweller, 1979). The rural turnaround, whether defined as a reversal in the decline of rural population in an area or reduced net outmigration rates, signals fundamental structural changes which we have yet to address in regional forecasting. The typical input-output or economic base methodology is static in that fixed coefficients are used. Many studies even assume *a priori* that the marginal multiplier is equal to the average -- a completely linear system. Lagged variables in a model may anticipate different relationships for units in a system but do not capture changes in the structure of the whole system through time.

The literature reporting the population turnaround and the studies searching for explanations pose important practical and theoretical questions -- to what extent do structural changes in the nation's and a region's economy alter employment and population, and further, how can we account for structural changes in forecasting and impact analyses? The purpose of this paper is to isolate some indicators of structural changes in rural economies, changes which may be contributing to their revitalization. Quite frankly, the objective is to stimulate a general discussion among practicing model builders about how structural changes might be incorporated into workable models. The utility of accounting for structural changes in forecasts is quite clear. Planners need to know whether growth will come about even if the economic base remains stable. In impact analysis, the interest is not only in forecasting the baseline conditions but also the extent to which new industry will successively alter the baseline forecasts. These are a fundamental part of impact analyses in rural counties facing energy exploration. But, it is also an important consideration in the areas which are experiencing a population turnaround and especially in areas which are growing rapidly.

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Existing models have failed to explain the population growth of nonmetropolitan regions both in this country and other industrialized nations of the world. The fact that other industrial nations are experiencing a rural-urban turnaround and that the start of that turnaround roughly coincides in time should indicate that, whatever the cause, it is not unique to the United States (Vining and Kontuly, 1978). Nonmetropolitan growth seems to be a pervasive phenomenon in the United States affecting all regions and all types of rural counties regardless of size and proximity to metropolitan areas. Growth in rural counties adjacent to metropolitan areas might be explained by metropolitan spillover. But, the revitalization of the most isolated and rural counties was almost totally unexpected. Even rural counties not adjacent to metropolitan areas grew more rapidly and had a higher rate of net inmigration than the metropolitan areas. Surprisingly, the nonmetropolitan counties with the smallest urban centers (less than 2,500 people) grew the most rapidly and had the highest annual rate of net migration (Table 1).

Aggregate income data for metropolitan and the nonmetropolitan counties of the nation demonstrate that important changes are occurring in the relationship between the national economy and activities in rural areas. Data presented in Table 2 suggest that the changes in industrial composition of nonmetropolitan counties cannot be adequately explained by the changes in the composition of the national economy as a whole. Every personal income component except transfer payments and services grew more rapidly in nonmetropolitan counties than in metropolitan counties from 1968 to 1975 (Bluestone, 1979). The growth rate was even more pronounced in totally rural and nonadjacent counties with population centers of less than 2,500 people.

The past theories would not have anticipated the shift of manufacturing into nonmetropolitan areas or growth of other sectors in those areas. The Thompson (1967) hypothesis is that industries filter down through the system of cities from places of greater to lesser industrial sophistication. New and fast growing industries would concentrate in urban areas which can supply the necessary infrastructure and pool of trained labor to nurture them. As industries mature and their production processes become routinized, they would move out of cities to escape the high wage rates and other diseconomies which might overshadow

TABLE 1. ANNUAL RATES OF POPULATION CHANGE AND NET MIGRATION, BY METROPOLITAN. AND NONMETROPOLITAN LOCATION CATEGORIES, UNITED STATES 1950-1960, 1960-1970, AND 1970-1974

County characteristic and location	Annual rate of population change			Annual rate of net migration			Number of counties
	1950–1960	1960–1970	1970–1974	1950–1960	1960–1970	1970–1974	
United States	1.69	1.25	.92	.16	.17	.23	3100
Metropolitan	2.32	1.57	.79	.78	.44	.07	629
SMSAs 1 million up							
Core counties	1.70	1.07	– .09	.35	.05	– .69	48
Fringe counties	4.41	2.88	1.54	2.75	1.66	.79	129
SMSAs 250,000 to 1 million	2.37	1.61	1.21	.70	.42	.42	261
SMSAs less than 250,000	2.08	1.43	1.45	.35	.18	.60	191
Nonmetropolitan	.30	.43	1.27	–1.23	– .54	.67	2471
Adjacent	.54	.71	1.42	– .92	– .23	.82	989
SLP 10,000 up[a]	1.11	1.03	1.40	– .40	.01	.72	259
2500 to 10,000	.02	.36	1.39	–1.39	– .50	.87	460
Less than 2500	– .39	.22	1.67	–1.81	– .62	1.18	250
Not adjacent	.05	.14	1.13	–1.53	– .85	.62	1502
SLP 10,000 up[a]	1.04	.63	1.20	– .65	– .53	44	271
2500 to 10,000	– .45	– .18	.92	–1.98	–1.05	.41	597
Less than 2500	– .99	– .37	1.39	–2.45	–1.17	.97	634

a/ SLP stands for population size of largest place in the county as of 1970.

Source: *"The New Pattern of Nonmetropolitan Change," by Calvin L. Beale and Glenn F. Fuguitt. Social Demography. New York: Academic Press, 1978.*

TABLE 2. PERCENT CHANGE IN TOTAL PERSONAL INCOME, METRO AND NONMETRO CATEGORIES, 1968-1975

Income component	Percent growth 1968-75		
	Metro	Nonmetro	Totally rural nonadjacent
Total personal income	78.6	98.0	117.7
Property income	82.3	105.6	119.4
Net transfer payments	249.1	209.0	186.1
Earnings	68.3	84.6	106.1
Manufacturing	46.8	67.5	84.3
Government	85.4	88.2	91.3
Trade	70.9	83.6	90.4
Services	86.2	85.8	98.7
Transportation, public utilities & communications	77.0	90.6	107.3
Contract construction	55.7	88.8	194.8
Finance, insurance & real estate	68.0	86.3	122.2
Agriculture, forestry, & fisheries	87.9	95.6	101.1
Mining	118.8	155.8	223.7

Source: "Income Growth in Nonmetro America, 1968-75," by Herman Bluestone, USDA/ESCS Rural Development Research Report No. 14, August 1979.

possible agglomeration benefits. Several empirical studies using pre-1960 data tend to support this theory, but a recent study by Petrulis (1979) using 1967 to 1973 does not. Nonmetropolitan regions of the nation were gaining manufacturing employment because of an increased share of both slow growth and fast growth industries.

The growth of other economic sectors in rural areas also was not anticipated by previous concepts because it was assumed that economies of scale in firms and economies of agglomeration of places would dominate the location matrix. Without economies of size, small but efficient firms would be located in dispersed patterns. Data in Table 2, however, suggest that other sectors are growing in rural areas. Unfortunately, future rural/urban patterns of the location of sectors are difficult to predict because too many factors are changing. Agglomeration economies which might now exist in metropolitan areas may become obsolete in the future due to rapid advances in communications technology. Countervailing diseconomies may surface due to social and other changes such as growing crime rates and an increased sensitivity to pollution and congestion. Technological advances may support the dispersion of industries. The cost of electric power in the future may give new areas an industrial advantage. It should be clear that the diversification rural areas have undergone in their industrial mix bodes well for the future, and that rural economies are no longer as dominated by the vagaries of agricultural prices and weather and should expect to participate in long-term expansions of the national economy as well as structural changes which could add to their growth potential.

DEFINITIONS AND DATA

Economic structure is defined as the set of behavioral relationships within and among regions of the nation and the world. A classification of structural changes may be useful for conceptualization even though it is beyond the scope of this paper. Periodic structural changes may come about due to threshold effects or alterations in expectations which accompany cumulative change. At some size, a growing town starts to perform the function of a regional trade center. Cyclical structural changes can be brought about by national business cycles. Behaviors in each phase of the cycle may be different, cycles may be the mechanism for industry location shifts, and the accelerator may operate during these cycles. Finally, the secular changes in structure discussed below may appear over time in response to technology, institutions, ethics, or tastes. Truly dynamic models would include a specification for each type of structural change. An easier albeit difficult task is to specify only secular structural changes.

The data used in this discussion are drawn from the Bureau of Economic Analysis and the decennial census. The Bureau of Economic

Analysis (BEA) data for both employment and population are estimates. Employment is presumed to reflect the place of work while population is reported by place of residence in the BEA data.

Counties are classed by metropolitan status, and nonmetropolitan counties are further classified by urban population size and adjacency to metropolitan areas. This classification minimizes errors in the data due to reporting, and standardizes for shopping and work commuting patterns. The urban to rural continuum of counties allows rural counties to be highlighted even though the data presentation is made complex.

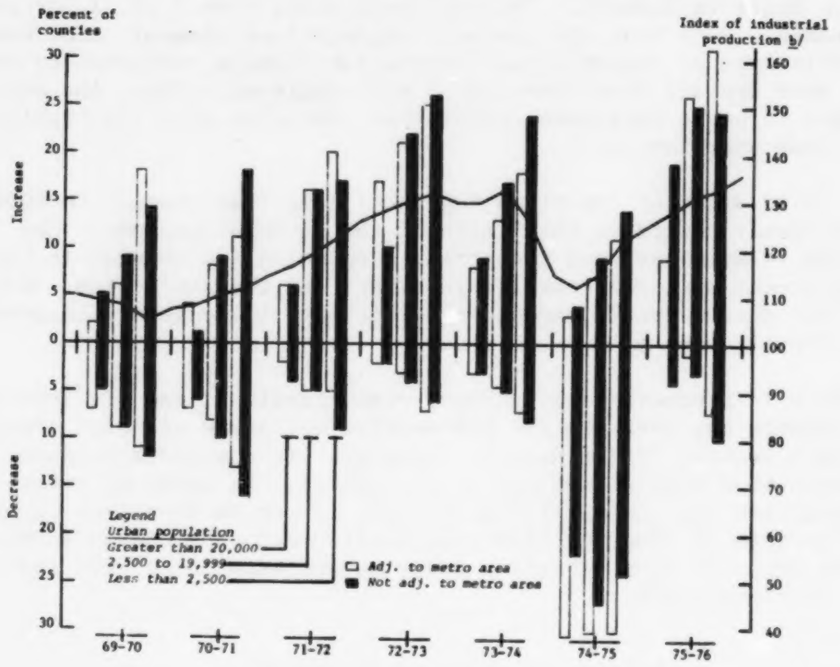
The data with which we have to work merely indicate manifestations or symptoms of changes in behavioral relationships. For pedagogic purposes we choose to isolate five indicators of structural change for discussion. They are the relationships between (1) the national economy and the basic sectors in rural areas, (2) basic activities and service activities, (3) employment and population, (4) migration and income, and (5) transportation costs and the regional distribution of activities. These can be viewed as coefficients of a very simple regional forecasting model. The basic sectors of rural areas will be tied to that of the national economy. Economic base concepts dictate some relationship between basic activities and service activities in an area. The number of people in a region is a function of employment, labor force participation, and income. Finally, the distribution of service activities within a region should be dependent upon transportation and access costs.

LINKAGE TO THE NATIONAL SYSTEM

Rural counties have become closely linked to the national economy. They are affected by long-term expansions of the national economy as well as cyclical fluctuations. This is illustrated by the changes in employment in basic economic sectors of rural areas (excluding farmers who do not respond to the same cyclical pattern). The proportion of nonmetropolitan counties with more than a 10 percent change in basic employment each year is shown in Figure 1 for the period 1969-1976. The proportion of counties in each urban class increasing more than 10 percent is in the upper part of the graph, and the proportion decreasing is in the lower frame. Superimposed over the bar graph is an index of U.S. industrial production. Three implications are apparent.

The first implication is that employment change is common to most nonmetropolitan counties regardless of their size or location. Large proportions of counties exhibit more than a 10 percent change in basic employment. Between 1974 and 1975, 34 percent of the adjacent rural counties with urban populations greater than 20,000 had a change in basic employment greater than 10 percent -- 31 percent declined and 3 percent gained. In 1974-75, the total proportions increasing and

FIGURE 1. PERCENT OF RURAL U.S. COUNTIES INCREASING OR DECREASING IN EACH YEAR MORE THAN 10 PERCENT IN WAGE AND SALARY EMPLOYMENT IN BASIC ECONOMIC SECTORS a/, BY RURAL CLASS, 1969-1976



a/ Basic sectors are farm, mining, manufacturing, heavy construction, railroad, motor freight, water transport, and federal wage and salary employment.

b/ 1967 = 100.

decreasing ranged from 26 percent of the urban nonadjacent counties to 41 percent of the rural counties adjacent to metropolitan areas. Over the whole period, many if not most counties have been subject to rapid changes in basic employment.

Second, year-to-year variability is common. During 1974-75, 22 to 31 percent of rural counties registered decreases greater than 10 percent in basic employment. The very next year, from 9 to 31 percent had increases. Note that the temporal aggregations commonly used tend to mask this type of variability. Population changes and mobility are probably more dynamic than revealed by most analyses. Thus, not only are changes in basic employment widespread, but also they are highly variable from year-to-year.

The third and most important implication is that changes in rural areas are firmly rooted in the health of the national economy. The association between national industrial production and changes in the basic employment of rural counties is clear. By the same token, rural parts of the nation should expect to participate in long-term expansions of the national economy.

Changes in production technology, communications, and transportation on balance may increase the comparative advantage of rural areas in the basic sectors of the nation's economy. That would mean more rapid growth than that of the nation as a whole. In terms of structural change and the timing of that change, it may be important to note that the process of removing older and inefficient productive capacity from urban areas to less urbanized areas may be associated with the national business cycle.

THE MIX OF SERVICE EMPLOYMENT

The ratio of service employment to total employment over time provides some evidence that the basic to service employment mix is changing in rural areas. Historical census data are reported in Table 3. The proportion of service activities to total employment has been increasing in the nation and in rural areas for several decades. In 1940, 46 percent of total employment was in selected service sectors in the nation. By 1970, the proportion was 61 percent. The service ratio in selected Northern Plains states and counties dramatizes the fact that the change is consistent with that in many rural areas and is not concentrated in urban centers alone. Note that by 1970 the service to employment ratio was higher in Montana, Wyoming, and North Dakota than in the nation, even though it was somewhat lower in 1940. The same pattern is evident in selected rural counties of these three states even though the economic activities there were dominated by an agricultural base in this period.

TABLE 3. PERCENT SERVICE EMPLOYMENT, SELECTED AREAS 1940-1970 a/

Area	Year 1940	1950	1960	1970
United States	46	49	55	61
Montana	41	47	56	63
Rosebud	34	33	51	56
Wyoming	44	49	55	63
Campbell	30	35	44	45
North Dakota	37	41	53	65
Mercer	23	30	41	51

a/ Service is other transportation, utility services, wholesale and retail, finance, insurance, real estate, business and personal services, and government.

Source: Regional Employment by Industry, 1940-1970, U.S. Department of Commerce, Bureau of Economic Analysis, n.d.

The proportion of total employment in the same service sectors has continued to increase through the 1970's in all nonmetropolitan areas (Table 4). No pattern of change is discernible among the various urbanization classes. All areas show an increase during this period of about the same magnitude.

The important point is that the service employment mix is high in rural areas and increasing, and that service activities are geographically dispersed much more than in the past. Service activities have been characterized as being uniquely suited to centralized urban locations. These data suggest that the degree to which service employment is centralized in urban places can easily be exaggerated because large differences among rural and urban areas are not evident.

The secular increase in service employment can be explained by income increases, the cost of access and transportation, changes in service technology and innovations, and the composition and technology of basic industries. We suggest three implications of these data for purposes of modeling the economies of rural areas. First is the obvious increase in service employment per unit of basic employment in a region. That means service employment may increase even though the economic base of a region remains stable. Second, service employment seems to be dispersing into rural areas rather than remaining centralized in regional trade centers. Third, we might suggest that an important new function for the old trade centers is that of providing excess service capacity which is used to absorb rapidly changing demands from year-to-year in the surrounding hinterland.

LABOR FORCE PARTICIPATION RATES

One of the more dramatic structural changes in rural areas is the proportion of the population in the labor force. The labor force participation rate of the people living in nonmetropolitan areas has increased to 60.7 percent of the working age population in 1979 compared with 64.2 percent of those in metropolitan areas (Bureau of Labor Statistics, 1974-78). Total labor force participation of farm people was 61.2 percent by early 1979. Many of the recent changes in labor force participation are due to the entry of women into the labor force. Brown and O'Leary (1979) report that between 1960 and 1970, 89 percent of the increase in nonmetropolitan employment was comprised of women. In 1978, 43 percent of farm women in nonmetropolitan areas were in the labor force. It is not surprising that off-farm income contributed 57 percent of the personal income of the farm population in 1977 (Carlin and Ghelfi, 1979).

Labor force participation rates for counties over the 1969-76 period are not available. However, a superior measure for purposes of modeling is employment relative to the population. This ratio indicates the

TABLE 4. PERCENT SERVICE JOBS OF WAGE AND SALARY WORKERS BY URBAN CLASS, 1969-77 a/

County class	1969	1970	1971	1972	1973	1974	1975	1976
Metropolitan Areas								
Greater than 1,000,000 population b/	61	63	64	65	65	65	67	67
250,000 to 999,000 population	55	56	58	59	59	60	62	62
Less than 250,000 population	56	57	59	59	60	60	62	62
Nonmetropolitan counties adjacent to metro areas b/								
Greater than 20,000 urban population	50	52	53	54	54	54	56	56
2,500 to 19,999 urban population	52	53	54	55	54	54	57	56
Less than 2,500 urban population	54	55	55	55	55	55	58	57
Nonmetropolitan counties not adjacent to metro areas b/								
Greater than 20,000 urban population	52	53	55	55	56	56	58	58
2,500 to 19,999 urban population	54	55	56	56	56	56	58	58
Less than 2,500 urban population	56	57	57	58	58	58	60	60

a/ Service sectors include wholesale and retail trade, finance, insurance, and real estate, business, personal and other services, communications, other transportation, general building contractors, and local government.

b/ County class defined in "Social and Economic Characteristics of the Population in Metro and Nonmetro Counties, 1970," by Fred K. Hines, David Brown, and John Zimmer, AER 272, ERS,USDA, March 1975.

Source: Center for Social Data Analysis, Montana State University from the Bureau of Economic Analysis, Department of Commerce data series.

potential for labor force entry of those who are not currently in the labor force. Furthermore, a high employment to population ratio can be interpreted unambiguously as a high labor force participation rate.

Employment per 100 population is high in the nation and has increased gradually over the period (Table 5). The increase has been interrupted by periodic recessions. Rural counties not adjacent to urban centers also have high employment ratios, and the ratios are tending to increase over the recent period. The data do not show a more rapid increase in the employment ratio in rural counties than in urban areas as in the past.

The major conclusion from these data is that the employment ratio already is high in rural areas, but is continuing a gradual increase. Further employment increases in rural areas will require either an increase in labor force participation, inmigration, an upgrading of jobs, or a combination of all three. An increase in labor productivity through job upgrading could be an important contribution to rural development, and would substitute for inmigration. It is clear that in areas with rapid increases in employment, migration will be the major source of labor because participation rates are already high in rural areas. Thus, rural areas will be competing directly with urban areas for additional labor, especially in periods when the working age population is increasing slowly.

INCOME CHANGES

Increases in wages of people in rural areas will be necessary to attract inmigrants as employment expands. Elsewhere we have hypothesized that the indigenous population would respond rapidly to higher wages by entering the labor force (Bender, 1979). As labor force participation rates increase in rural areas, new employment opportunities will require even higher wage increases in order to attract migrants. And if the labor force participation rates of people in rural areas peak, then wages will have to rise at least to levels competitive with those in labor sheds of surrounding areas.

Average earnings and per capita personal income both tend to be increasing more rapidly in rural parts of the nation than in urban areas. The patterns of the two measures are approximately the same except that net farm income (after inventory adjustments) leaped 79 percent from 1972 to 1973, then returned to 1972 levels by 1976. This farm entry distorts the rural income data. Average earnings of wage and salary workers are used instead to illustrate the decline in income differentials among rural and urban parts of the nation.

TABLE 5. TOTAL JOBS PER HUNDRED POPULATION BY URBAN CLASS, 1969-1976

County class	Year 1969	1970	1971	1972	1973	1974	1975	1976
Metropolitan Areas								
Greater than 1,000,000 population a/	47	47	46	46	47	48	47	47
250,000 to 999,999 population	43	42	42	43	44	44	43	44
Less than 250,000 population	43	42	42	42	43	44	43	44
Nonmetropolitan counties adjacent to metro areas a/								
Greater than 20,000 urban population	41	40	40	40	41	42	40	41
2,500 to 19,999 urban population	38	37	37	38	39	39	38	39
Less than 2,500 urban population	34	34	34	34	35	35	34	35
Nonmetropolitan counties not adjacent to metro areas a/								
Greater than 20,000 urban population	44	44	44	44	45	46	45	46
2,500 to 19,999 urban population	39	39	39	40	41	41	41	42
Less than 2,500 urban population	37	37	37	37	38	38	38	38

a/ County class defined in "Social and Economic Characteristics of the Population in Metro and Nonmetro Counties, 1970," by Fred K. Hines, David Brown, and John Zimmer, AER 272, ERS,USDA, March 1975.

Source: Center for Social Data Analysis, Montana State University from the Bureau of Economic Analysis, Department of Commerce data service.

Annual earnings of workers increased 64 percent between 1969 and 1976 in the most rural counties of the nation, from $4,300 to $7,109 (Table 6). The corresponding increase in large metropolitan centers was 58 percent, from $7,299 to $11,521. The differential between these two extremes remains wide. In part, it may reflect cost of living and quality of life. But, the differential is slowly closing.

The relative earnings increases in rural areas may be due to changes in the industry mix of employment, productivity of workers, or the supply of labor. Regardless which is the cause, earnings increases should tend to reduce emigration and increase inmigration.

Relative earnings in counties containing no urban center and not adjacent to an urban area were 67 percent of the national average in 1969 and 69 percent in 1976. Earnings in the most rural county groups which were adjacent to an urban center increased 4 percentage points to 73 percent of the national average by 1976. Earnings in the largest metropolitan areas declined from 113 to 112 percent of the national average over the period.

It is noteworthy that personal income per capita in the largest urban areas declined from 117 to 114 percent of the national average, a larger loss than reflected in earnings. Personal income includes proprietor's incomes, interest, and transfer payments. Furthermore, the income differentials adjusted for cost of living would be less than those for earnings (Hoch, 1972a, b). The slow but persistent increase in relative incomes in rural places will tend to hold and attract population, and earnings should increase relative to the nation as an inducement to emigrant labor.

ACCESS AND TRANSPORTATION COSTS

The continued participation of rural areas in the geographic dispersal of service activities will depend upon the distribution of services within functional economic regions -- the spatial structure of economic activities. Access and transportation costs and scale economies usually are isolated as the most important determinants of the spatial location of activities. The question is whether high relative petroleum prices will cause basic sectors to shift to urban areas, and whether service activities will tend to centralize in urban places.

The fundamentals of aggregate energy economics in the national system after all trade offs have been accounted for are that labor will substitute for energy, that the rate of capital formation will decline, and that labor productivity will decline as energy prices increase (Ozatalay, Grubaugh, and Long, 1979; Berndt and Wood, 1979).

TABLE 6. ANNUAL EARNINGS PER WAGE AND SALARY WORKERS RELATIVE TO U.S. BY URBAN CLASS OF COUNTY, 1969-1976 a/

County class	Year 1969	1970	1971	1972	1973	1974	1975	1976
Metropolitan areas								
Greater than 1,000,000 population b/	113	113	113	113	113	112	112	112
250,000 to 999,999 population	98	99	99	99	99	99	99	99
Less than 250,000 population	91	91	91	92	92	92	92	93
Nonmetropolitan counties adjacent to metro areas b/								
Greater than 20,000 urban population	88	87	87	87	88	88	88	88
2,500 to 19,999 urban population	75	75	76	76	76	77	77	78
Less than 2,500 urban population	69	70	70	70	70	71	72	73
Nonmetropolitan counties not adjacent to metro areas b/								
Greater than 20,000 urban population	83	83	84	84	85	85	86	86
2,500 to 19,999 urban population	74	74	74	74	74	75	76	77
Less than 2,500 urban population	67	66	67	67	67	68	69	69
Total all U.S. counties	100	100	100	100	100	100	100	100

a/ Weighted county averages by place of work.

b/ County class defined in "Social and Economic Characteristics of the Population in Metro and Nonmetro Counties, 1970," by Fred K. Hines, David Brown, and John Zimmer, AER 272, ERS,USDA, March 1975.

Source: *Center for Social Data Analysis, Montana State University from the Bureau of Economic Analysis, Department of Commerce data series.*

The net change in the aggregate system due to energy prices is summarized by the elasticities of substitutions cited above. Examples of specific cases may be misleading for that reason. In general, higher energy prices are consistent with the experience of the nation in the past decade. More labor is being used as energy prices increase, and the productivity of labor is declining. Since capital and energy are complements, higher energy prices retard the rate of capital formation.

The rural economy is only a subset of the national system and the same general effects may not be felt in rural areas. At this time it is a subject of speculation. However, in the farm sector, it would imply a slower adoption of energy consuming technology, hence, a slower release of labor from farming than in the past. This would tend to stabilize employment in a basic economic sector of rural areas. Food manufacturing is a uniquely rural industry and possibly would be affected in the same way.

The effect on the location of manufacturing activities in rural areas is subject to many more trade offs. One of the original reasons that manufacturers located in rural areas was that their transportation costs were relatively unimportant. Higher gasoline costs may change that matrix somewhat. On the other hand, there may well be a regional redistribution of some industries to areas which have less expensive process energy costs.

Possibly the greatest effect on the structure of rural economies will be in the service sectors. Increased gasoline costs should reduce the number and length of shopping commutes by rural people. The resulting increase in the demand for services locally even though prices might be higher would complement the long-term trend of increasing service activities in rural parts of the nation at the expense of regional service centers. As mentioned earlier, the major function of regional service centers in this case may be to provide enough excess capacity to absorb the variable service sector demand of its hinterland.

SUMMARY AND DISCUSSION

The population turnaround in rural areas calls attention to the possibility of structural changes in rural economies, changes which may have caused or which accompanied the population turnaround. Integration of rural economies into the national system, greater dispersion of services into rural areas, increased demand for service activities, higher labor force participation rates, and higher relative incomes are all reflected in data for rural areas. These changes appear to be caused by a complex set of forces which we failed to take account of in regional models -- the technology of production (especially in services), advances in communication, changes in transportation systems and the relative cost of transportation, the functions of towns and cities, and changes in values, ethics, and preferences. Although these data may alert us to structural changes which should be a part of regional modeling of employment and population, there is a long step between the recognition of the importance of structural changes and the inclusion of them in economic models.

A regional economy is a subset of the nation. These data suggest treating it explicitly in that way rather than as an isolated economy with a constant structure. To a large extent, the behavior evident in a county economy is dominated by and a reflection of what is happening in its national cohorts. Thus, one would expect increases in relative incomes, labor force participation, and service activities even though there may not have been a change in the economic base or a new surge in consumer demand. Too often these effects are ascribed to rapid changes in the economic base of growing areas. A major deviation of behavior in a county from the norm of its national cohort would be expected if background conditions such as rapid changes in its economic base were occurring. These differences between conditionally expected events in national cohort counties and the observed values of a sample of object counties could define the adjustments being made in a rapid growth situation. A large increase in the economic base would precipitate a rise in wages and salaries, participation rates, and service employment greater than that of other counties not experiencing that change. Thus, long-term structural changes and business cycles would become a part of the norm of the system.

Nerlove (1979) describes the ideal toward which we might strive and provides some general insights into initial attempts at modeling the dynamics of economic change.

> " . . . An econometrically relevant dynamic theory would characterize response paths of economic agents who are optimizing their behavior under dynamic conditions and forming expectations of the future on the basis of all information available to them. Such a theory would not, in general, involve the notion of a long-run equilibrium toward which adjustment is being made nor simple forms of stationary expectations."

His application is on perennials and livestock in developing agricultural economies. It is not the purpose here to review his work, but only to suggest that his summary of the state-of-the-art is important at this stage. Nerlove's parting remark is "Sophisticated econometric techniques and high-powered economic theory are complementary, not antithetical, to case studies and common sense." It appears that there is a great deal of room for all types of research in this area if we are to come to grips with the set of forces affecting rural areas.

The Economic Development Division's objective in this research is to more fully understand the process of adjustment to rapid growth in rural areas. We are planning additional work this year as a part of the Energy Impact Project. The first step is the selection of a sampling frame of counties. That involves screening for metropolitan status, size of urban population, adjacency to large metropolitan areas, and anomalies such as large minority populations, limitations on land use, presence of Federal establishments, concentration of state and local employment, retirement and tourist areas, and universities. From the screened sampling frame will be selected counties which will be used as national norms, and counties with changes in their economic base which appear to be desirable for estimating coefficients which apply to rapid growth areas. Coefficients will be re-estimated for the current equations in the COALTOWN model. At some point, new equations and a new model structure will be conceived.

We are working with undeleted BEA data for counties for the period 1969-1977. The data are commonly used for this purpose but data shortcomings are evident. Very early in our efforts this year, we will be faced by the serious trade off between the complexity of the model and its specification, and the complexity of the econometric problems faced and techniques used.

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A MANAGEMENT INFORMATION SYSTEM FOR ASSESSING LOCAL IMPACT OF ENERGY DEVELOPMENT

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INTRODUCTION

The Construction Labor Demand System (CLDS) is an outgrowth of continuing efforts under four Secretaries of Labor to obtain more accurate information about the construction industry and to enhance planning and policy-making relative to construction both in and out of government. These include methods of monitoring industry activity and labor market conditions, as well as a capability to conduct research on construction and construction labor markets. This information can be used to influence industry activity in beneficial ways. The concept was initiated during the period of economic controls in 1972 when there was severe wage and cost inflation in construction. Those first tracking systems have evolved into a sophisticated system which is being used as an important economic forecasting tool.

CLDS is a management information system that has been designed to provide users in the Department of Labor (DOL) and others with short-term forecasts for 1 to 5 years of the volume, type and regional location of future construction activity and the associated on-site requirements by individual crafts. Separate forecasts are developed for each state in the U.S., for each of 35 types of construction and 29 construction occupations, and for privately and publicly owned facilities. The function of the system is to estimate construction activity by type in geographical regions, primarily states, translate the estimated construction volume into labor requirements by converting project characteristics (dollars, megawatts, etc.) into craft labor time and forecast both construction activity and labor demand.

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CONSTRUCTION, JOBS AND LOCAL IMPACT

Thousands of new jobs will be created annually during the next decade as a consequence of the development, transportation, and processing of fuels and the development of new electrical generating capacity and other heavy construction, both of which are required for continued economic growth. These jobs will involve construction, maintenance, and operation of facilities. Individual projects in many cases will be so large in size that they will have drastic impact on local and regional labor markets.

The CLDS program has unique capabilities with respect to assessing the local impact of major development particularly in the energy area. One of the objectives in initiating the CLDS effort was to develop, for the participating Federal agencies, a capability to assess the labor and other resource requirements of alternative U.S. energy development scenarios. To accomplish this goal, the CLDS staff has initiated the development of a continuously updated computerized file of all announced and on-going energy projects in the U.S. (electric generating plants, transmission lines, and fuel extraction, processing, and transportation facilities). Under authority granted to CLDS by OMB, each energy construction project is monitored on a periodic basis; project stocks are converted into time-phased flows of labor requirements -- construction, operation and maintenance.

The implications for rural job development are enormous and are discussed in detail in the last section. The Construction Labor Demand System is described first so that the reader can assess its applicability to rural job development.

Project Data Base

Detailed and accurate information on construction projects is the nucleus of the CLDS system. It plays a critical role for assessing the construction situation and labor markets but also provides valuable insight to future levels of activity for those types of construction featuring long-lead times and lengthy construction periods.

Project data are entered into CLDS from private and government sources. The most important source in terms of quantity of project records is the monthly statistical file from the F.W. Dodge Division of McGraw-Hill Information Systems Company, Incorporated. A monthly magnetic tape from Dodge (Dodge Construction Potentials) provides information for 267 structure types of projects about to begin construction. From Dodge sources, 125,000-175,000 new projects are entered into CLDS each year.

Information on planned energy-related construction projects is gathered from other sources. The data source for fossil-fueled and hydroelectric units is the Energy Department's Generating Unit Reference File. This file, updated semiannually by CLDS questionnaires to the utility companies, provides all of the plant and location characteristics necessary to generate manpower requirements.

The data source for all nuclear electric generating facilities, either presently under construction or planned for future construction, is the Construction Status Report (Yellow Book) of the Nuclear Regulatory Commission's Office of Management and Program Analysis. This file, updated monthly by NRC, provides all plant and location characteristics necessary to generate manpower requirements.

For energy projects other than powerplants, CLDS has a cooperative arrangement with the Department of Energy (Energy Information Administration, EIA), whereby we maintain a computerized file containing a record for each planned (announced) energy project in the U.S. (approximately 90 different types of fuel extraction, processing, and transportation construction projects). EIA field offices collect the initial project data from secondary sources and report the data to CLDS. DOL then contacts project owners by telephone to obtain missing data on the projects which are required to convert stock of projects into flows of on-site construction (and operation and maintenance) labor requirements.

Labor Conversion

The construction activity-labor requirements transformation utilizes survey and engineering derived data to convert a stream of construction activity by final use characteristics into labor requirements over time.

For non-energy construction, CLDS translates given levels of activity into man-hour estimates by applying base-year coefficients of labor craft time per dollar to each type of construction. The estimated real value of construction (nominal value deflated by an appropriate construction cost or price index) is multiplied by a labor conversion factor to obtain estimated work-hours for each on-site occupation. For energy projects, the labor requirements flow and duration for specific projects are a function of type, output, cost and engineering criteria.

The construction period is subdivided into deciles and labor requirements are estimated separately for each decile, since labor involvement for any given construction trade varies over the duration of the project as different construction stages ensue. If a given type of construction project of a certain dollar volume is estimated to take

20 months to complete, the CLDS program would automatically estimate the labor requirements by craft for each two month period of construction.

Factors for accomplishing the conversion are derived from BLS surveys of labor and material inputs for selected types of construction and on the basis of engineering evaluation of construction resources needed to build facilities. Approximately 250 separate conversion profiles are included in the system.

Forecasting

Future and as yet unknown construction initiations are generated from models developed by CLDS for energy-related construction, and for CLDS by the Institute for Defense Analyses (IDA) for other types of construction. The logic and assumptions underlying both the energy and nonenergy components are similar enough to allow aggregation when desired into one overall forecast for a designated geographical area.

Briefly, the forecasting method for nonenergy construction is as follows: The first step is utilization of a set of forecasted regional economic activity and demographic variables. The projected values represent a capsule summary of the anticipated health of a region, its rate of economic growth, the composition of its industry, and the age and social structure of its population.

The National Regional Impact Evaluation System (NRIES) model developed by the Bureau of Economic Analysis of the Commerce Department is the source of the economic and demographic forecast. It is a set of 51 state models estimated from time series data using a common theoretical structure. Each state model is composed of 69 behavioral equations and generates the state forecasts which provide the regional inputs to our construction model. An interagency agreement between DOL and DOC provides for access to NRIES by CLDS and also makes provisions for periodic modification by the NRIES staff of the model to meet CLDS requirements.

A model in CLDS relates construction activity in each state to local and national variables which are thought to influence the level of activity. The model converts measures of construction activity and demographic characteristics into estimates of construction starts for each type of construction included in the system. For example, private school construction is related to the size of the school population and disposable income. These variables, plus tax revenue per capita as a measure of fiscal efforts, are used to explain demand for public schools. Hospital construction is related to income, fraction of the population who are elderly, and Federal grants in aid.

Three steps are required to forecast nonelectric energy construction activities in terms of energy supply facilities. First, the forecasted energy supply (production) including energy transportation is generated by type and region over time from selective energy supply models such as Midterm Energy Forecasting System in the U.S. Department of Energy, (the basis for the Annual Report to Congress, 1978 by EIA of DOE). Second, new additions of required energy capacities by region are estimated, based on the forecasted energy supplies.

Required information includes capacity utilization, existing capacities, facility retirements and known projects planned by producers. An Energy Pseudo-Project Generator in the CLDS model prescribes construction requirements to meet energy needs. It generates information on calendar month of construction start, project size, project type, and location.

IMPLICATIONS FOR RURAL DEVELOPMENT

A casual analysis of the energy project file reveals one fact of major significance -- energy projects are predominantly rural in situs. When the manpower requirements profiles for energy construction are compared to the labor force in many counties in which future plants are scheduled for construction, the peak construction work force, in many instances, will exceed the county's entire nonagricultural labor force. Boomtown phenomena will be commonplace without adequate planning and intervention.

All too often craftsmen from distant parts of the nation (and Canada) immigrate to the site of major energy projects, attracted by potential annual earnings often exceeding $30,000, while local young people entering the labor force continue trekking to distant cities seeking jobs with much lower earning capacities than those of the new jobs in their native counties.

Although unionized projects and open shop projects vary with regard to utilization of locally trainable labor, either arrangement can lead to an inefficient utilization of the local labor supply unless special labor recruitment and training activities are undertaken.

Employment in the construction industry is inherently unstable due to certain immutable characteristics of its product market. Each project is essentially an immobile, customized, unique product; therefore, productive factors must be shifted among the different owners' sites. This is translated into a continuous assemblage and disassemblage of work forces by constructors as jobs progress from one stage to another and end at one location and begin at another. Frictional (as well as seasonal) unemployment is indigenous to the industry and is capitalized into the wage structure. Construction workers are accustomed to commuting long distances to or temporarily relocating near project work sites. Thus, the mobility of inputs rather than outputs in the construction industry induces local expansion from the influx of construction workers directly and indirectly as a consequence of their consumption of local goods and services.

CLDS can serve as an early warning system to identify geographic areas, specific projects, and even specific construction crafts where skill supply/demand imbalances are likely to occur as a consequence of energy development (and, for that matter, as a consequence of other types of construction). Local impact will be lessened by developing special cooperative recruitment programs and innovative apprentice or other training program arrangements (such as accelerating the first and second periods of apprenticeship by utilizing specially structured programs in local area vocational schools or technical institutes). Each local person trained in a critical craft reduces by one the movers to the project, but the dampening effect on overall expansion is much greater. (This point is subsequently treated in greater detail.) The average cost of employment to the work force is decreased since fewer workers have to maintain two residences, and social costs to the community are substantially reduced. Inflationary pressure on construction wages may be reduced because fewer movers have to be attracted.

When construction on the project is completed and operation of the facility is begun, a different and much smaller work force is required, often only 5 or 10 percent of peak construction employment. Some of the local construction craftsmen may become employed as maintenance craftsmen, but most of the operational work forces consist of managers, engineers, technicians, clerical workers, and security personnel.

The new local entrants into the construction trades would have to find new employment, as do the other craftsmen, when construction is completed; their alternatives to use their newly acquired human capital are the same (although utility functions may have quite different shapes). They may become movers within the construction industry; they may work for lower wages in local residential construction or local maintenance; or they may move to other areas to work at related jobs outside the construction industry. In any case, their relative wage positions would have been improved.

Thus far, only the direct job openings created in the construction industry have been considered. There are also obvious secondary employment effects which may be of interest to rural job planners, although these jobs may generally be less skilled. The exogenous shock of a new energy project induces two additional effects beyond direct growth in the construction industry. Output is increased by those local industries producing input goods and services for the construction industry and, as a consequence, employment in those industries is increased (and a likewise ripple through their input industries is initiated). CLDS (as do input/output results) will estimate time-phased profiles for 50 types of materials and equipment inputs for each energy type. An analysis of the structure of the local economy could then be made to estimate the indirect changes in employment by industry and by occupations associated with the expected change in output over time.

Another type of secondary employment that derives from the shock of an energy project is income-induced employment. The share of the construction workers income spent locally initiates a wave of economic activity which expands throughout the economy, the magnitude being determined primarily by the amount of income spent locally and its velocity. As local firms expand their output in response to consumption by the construction workers, their employment is expanded.

Although CLDS will not directly estimate income-induced or indirect employment from energy construction projects, systematic estimates could be made by merging the output of CLDS into the Industrial-Occupational Labor Demand Model developed at the University of Utah for DOL. This latter modeling effort involved an empirical investigation of actual local labor market situations, making use of an econometric modeling technique that incorporates a dynamic industrially disaggregated formulation of the traditional economic base concept.

In conclusion, CLDS in tandem with other regional models such as DOL's Region VIII Energy Impact Model, can be used to estimate direct and secondary job openings that are likely to result from the introduction of an exogenous energy project. The results may be used to lessen boomtown impacts and serve as a major strategy for job creation and training in rural areas by coordinating the training of local people with local job openings.

PROFILE OF INMIGRATING WORKERS AT LARGE CONSTRUCTION PROJECTS--IMPLICATIONS FOR MODELING

Suresh Malhotra
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INTRODUCTION

This paper focuses on the work force composition at nuclear power plant construction sites and attempts to determine the extent to which occupational groups exhibit differences with respect to variables which are critical to socioeconomic impact assessment. These findings have important implications for socioeconomic impact assessment and provide valuable insights for the development of improved forecasting procedures.

The results presented here represent the first phase of a study (Malhotra and Manninen, 1979) to develop methods by which information regarding the local labor profile prior to plant construction, anticipated construction worker requirements, and various regional characteristics can be used to predict:

1. The number of workers who will move to the area to work at the construction site; and
2. The residential location pattern of inmigrating workers.

This paper examines four variables critical to estimating socioeconomic impacts -- migrant proportions, relocation of dependents, intention to remain in the area, and demographic characteristics of movers -- and presents a brief summary of our findings.

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The discussion is divided into three sections. The first section introduces the data set used in the study and outlines the analyses performed. The second section presents the analysis results and discusses the implications of these findings for estimating socioeconomic impacts of large energy development projects. The final section summarizes the implications of these findings for the development of improved forecasting procedures.

ANALYSES PERFORMED

The data used in this study include the responses of over 49,000 workers from 28 surveys conducted at 13 nuclear power plant construction sites. These data were obtained in two ways. Worker surveys were conducted at four nuclear power plant construction sites specifically for this study. In addition, we were able to increase the number of sites in our analysis by including data from similar surveys which were conducted by utilities at nine additional sites.

These 28 surveys exhibit a wide range of variation in a number of important dimensions. For example, considerable variation can be observed with respect to regional distribution, the existence of other power plant construction activity in the region, local community characteristics, stage of project completion, utility and contractor arrangements, extent of unionization, and various power plant characteristics. Consequently the data can be expected to yield estimates of critical socioeconomic variables under a variety of situations. This increases the usefulness of such an analysis, since an examination of these data is more likely to yield results which are generalizable to a variety of power plant construction sites.

The variables which were included in the analysis are defined as follows:

1. Migrant proportion -- the proportion of workers who moved to the area to work at the site; 2/

2/ Workers were classified as movers and nonmovers in one of two ways, depending upon the survey instrument used. Some questionnaires asked workers whether or not they had moved to the area to work at the site. Workers who responded "yes" to this question were considered to be movers. Other questionnaires asked for the worker's current address and their address before beginning work at the site. A comparison of these responses was used to classify workers as either movers or nonmovers.

2. Relocation of dependents -- the proportion of movers with family present;

3. Intention to remain in the area -- the proportion of movers who are temporary (movers who intend to leave the area before or upon completion of the project); 3/ and

4. Demographic characteristics of movers -- marital status, family size, number of school-age children and income.

An accurate estimate of the number of inmigrating workers is critical to socioeconomic impact assessment because this projection is the single most important determinant of the magnitude of most other impacts. Similarly, consideration of information regarding relocation of dependents, intention to remain in the area, and the demographic characteristics of movers may be important because household composition and family size influence movers' demands for housing, consumer goods, and public services.

We examined the variation in each of the above variables across sites -- both overall and for various subgroups of workers -- with a view toward identifying patterns of association between variables which would be useful in the specification of the models to be estimated in the multivariate analysis portion of the study. No attempt was made to explain the observed patterns of variation during this portion of our analysis.

Differences in migrant proportions among various occupational groups have been observed in past studies (Mountain West Research, Inc., 1975). However, no attempt has been made to examine differences in variables such as migrant proportions, intention to remain in the area, and relocation of dependents among various worker groups in any systematic way. The intent of this analysis was to determine the extent to which workforce composition could be an important factor in understanding the observed variation in the variables of interest across sites.

3/ Two different measures were defined to examine this variable. First, based upon workers' responses to a direct question regarding their intention to remain in the area, we classified movers as either permanent or temporary movers. Temporary movers were defined to be those movers who expected to leave the area either before or on completion of the project. Second, as an indirect measure, we examined the proportion of movers who maintain a permanent residence elsewhere as an indication of intention to leave the area upon completion of the project.

The importance of considering work force composition stems from the fact that both the demand for labor at the construction site and the availability of labor within commuting distance vary for different craft groups. For instance, crafts with more specialized skills are required for jobs of rather limited duration, whereas other crafts are required throughout the entire construction phase. Moreover, other opportunities for employment in the area during and upon completion of the project vary considerably for different crafts. Since it is likely that these factors influence workers' relocation decisions, our analysis attempts to measure the extent to which differences in migrant proportions, relocation of dependents, and intention to remain in the area are observed among various craft groups.

First, we divided workers into two broad groups -- construction and nonconstruction workers. 4/ Each of these groups was then further subdivided. In the case of the nonconstruction group, workers were divided into two subgroups. The first group included all managers, engineers and supervisors. The second group included the remaining nonconstruction workers (i.e., the clerical, security, and medical/nursing staff).

We divided construction workers into three groups based on the relative scarcity of labor among the different construction crafts. This classification of crafts into scarcity groups was based on two factors: (1) the size of the craft labor markets, and (2) the demand for their services at nuclear power plant construction sites. We defined our proxy measure of relative scarcity of labor to be the ratio of the number of manhours of labor required in each craft to construct a typical nuclear power plant to the total number of union members in the construction craft in the nation. 5/

This ratio was used to classify all construction crafts except laborers and teamsters into two scarcity groups: a scarce craft group and a common craft group. The scarce craft group includes pipefitters, ironworkers, asbestos workers, and boilermakers. Carpenters, electricians, operating engineers, sheetmetal workers, bricklayers, and cement

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4/ Information on workers' crafts was not available for four of the surveys in our sample. Therefore, it was necessary to exclude these sites from our analysis of variation among various subgroups of workers.

5/ We recognize that this measure of relative scarcity of labor is rather crude. Ideally, this measure should have been based upon regional estimates of the demand and supply of the various construction crafts. Unfortunately, data to develop such a scarcity measure were not available.

masons comprise the common group. Laborers and teamsters formed the third scarcity group -- an abundant craft group. We treated laborers and teamsters differently from the other crafts because these jobs do not require very specialized skills. These occupations do not have lengthy apprenticeship programs, as is the case with other construction crafts. Therefore, it is relatively easy to meet an increase in the demand for laborers and teamsters by attracting workers from other occupations.

In addition to our examination with respect to various worker groups, we also examined possible variation in relevant variables with respect to region. Among the 13 sites included in our study, four were located in northern states and nine were located in southern states. We examined the data in an effort to determine the extent to which systematic differences exist between northern and southern sites.

RESULTS

Migrant Proportion

Table 1 presents a comparison of the absolute ranges and typical values -- both overall and for various worker groups -- for the 28 surveys included in this study. 6/ Large variation was observed in overall migrant proportion, and in the migrant proportions of most worker groups. Typically, overall migrant proportions ranged from 17 to 34 percent; however, there was considerable difference between the migrant proportions of the construction and nonconstruction groups. In general, migrant proportions among nonconstruction workers were two to three times higher than the migrant proportions among construction workers. Migrant proportions among nonconstruction workers typically ranged from 40 to 58 percent, whereas among construction workers migrant proportions typically ranged from 11 to 29 percent.

Differences were also observed when these two groups were further subdivided. The high migrant proportions observed among the nonconstruction group essentially reflect the extremely high migrant proportions of the management subgroup. In fact, migrant proportions among clerical workers were similar to those observed among construction workers. Migrant proportions among the management group typically ranged from 58 to 76 percent. Migrant proportions among the clerical group, on the other hand, typically ranged from 21 to 36 percent.

6/ We defined the range of typical values to be the smallest range of values which contained at least 75 percent of the observations of a particular group.

TABLE 1. VARIATION IN MIGRANT PROPORTION, OVERALL AND FOR VARIOUS WORKER GROUPS

	Migration Proportion	
	Absolute Range	Typical Values
Overall	15-50	17-34
Construction	7-52	11-29
Nonconstruction	28-68	40-58
Management	34-86	58-76
Clerical	10-46	21-36
Scarce	6-69	17-45
Common	7-51	9-28
Abundant	3-23	5-12

Within the construction group, the differences in migrant proportions among the three scarcity groups were not as extreme. Nevertheless, the differences were significant. Migrant proportions among workers from scarce crafts, which typically ranged from 17 to 45 percent, were higher than those among workers from the common crafts, which typically ranged from 9 to 28 percent. Migrant proportions among these two groups were considerably higher than migrant proportions among workers from the abundant craft group, which typically ranged from 5 to 12 percent. Furthermore, it is interesting to note that in the case of the abundant group, little variation in migrant proportions was observed from site to site. Much larger variation, however, was observed in the case of the scarce and common craft group.

These differences in migrant proportions are not surprising considering the likely availability of these groups in the area immediately surrounding the construction site. Consider, for example, the extreme difference between the management and clerical groups. Management workers are generally better educated and have relatively high salaries. These workers are not likely to be readily available in the area. especially in the case of more rural sites. Instead, many of these workers are regular employees of the utility or prime contractor and are moved to the area specifically to work on the project. Clerical workers, on the other hand, have jobs that require less education and training and, as a result, most of them are hired locally.

Construction workers also are more likely to be available locally. This is especially true among certain worker groups such as teamsters and laborers, since these jobs do not require extensive prior training. There are, of course, several rather specialized construction crafts, such as those represented in the scarce craft group, and the local labor supply may not be able to provide a sufficient number of such workers. Therefore, it is not surprising to observe greater numbers of movers among crafts which are relatively scarce.

As can be seen in Table 2, regional differences in migrant proportions were not very pronounced. Although we did observe some evidence of higher overall migrant proportions in the South, the difference between the two groups was not significant. A much more noticeable difference was observed when construction and nonconstruction workers were examined separately. Little difference was observed in the case of the construction group. However, in the case of the nonconstruction group, we observed a more obvious regional difference (migrant proportions typically ranged from 40 to 50 percent in the North and 52 to 56 percent in the South). Furthermore, in a further disaggregation of these two broad groups we observed that this difference was primarily due to a very pronounced difference for the clerical group. Migrant proportions among the clerical group typically ranged from 10 to 22 percent in the North compared with 26 to 30 percent in the South.

TABLE 2. VARIATION IN MIGRANT PROPORTION BY REGION, OVERALL AND FOR VARIOUS WORKER GROUPS

	North		South	
	Absolute Range	Typical Values	Absolute Range	Typical Values
Overall	15-26	21-26	21-47	21-32
Construction	12-25	12-23	14-52	14-22
Nonconstruction	28-50	40-50	33-63	52-56
Management	34-70	61-70	45-75	61-73
Clerical	10-27	10-22	13-30	26-30
Scarce	22-34	22-28	15-69	23-39
Common	7-27	7-14	12-51	12-22
Abundant	6-14	9-14	5-23	5-8

Although interesting, the reason for this regional difference in migrant proportions among clerical workers is not obvious. It is perhaps related to the differences in local availability of such workers in the two regions. Alternatively, the pattern could reflect differences in the hiring practices of the utilities or prime contractors.

The results of this analysis have clearly demonstrated a systematic variation in migrant proportions across worker groups. This implies that workforce composition could be an important factor in explaining the variation in overall migrant proportion across sites. Table 3 presents the proportion of the total workforce in each of ten craft groups at the time of the survey for the 24 surveys for which information on craft was available. As can be seen in the table, workforce composition varies considerably from site to site and at the same site at different stages of project completion. Because migrant proportions vary considerably for different worker groups and because workforce composition varies across sites, the variation in overall migrant proportions may, to a large extent, reflect differences in workforce composition. Thus, any attempt to explain the observed variation in migrant proportion across sites should explicitly include a consideration of workforce composition at the site at the time of the survey.

In addition, the results of this analysis can be used to identify the underlying factors which explain the variation in migrant proportions across different worker groups. While many such factors exist, in general, variables can be classified into the following two groups: those which reflect the availability of labor in the area and those which reflect the relative attractiveness of employment opportunities offered by the construction project.

The availability of labor varies considerably across craft groups as well as across sites, depending upon factors such as the urban/rural nature of the surrounding area. If there are several large cities within daily commuting distance of the site, one might not observe large numbers of workers moving to the area to work at the site. This may be particularly important among workers from the scarce crafts whose availability may be somewhat limited in rural areas. The attractiveness of employment opportunities for various craft groups depends upon the nature of labor requirements. This includes a variety of factors such as the total number of workers required, and the expected duration and continuity of employment. There is considerable variation in these labor requirement variables both across sites and across crafts. Since it is these variables which determine the expected value of benefits associated with employment at a particular site, it is therefore likely that these variables will also influence workers' relocation decisions.

Thus, this analysis suggests that any model which is developed to explain the observed variation in migrant proportions should include

TABLE 3. WORKFORCE COMPOSITION AT TIME OF SURVEY BY CRAFT GROUPS (PROPORTION OF TOTAL WORKFORCE)

Survey Identification Number	Pipefitters	Ironworkers	Boilermakers	Operating Engineers	Electricians	Carpenters	Other Construction	Laborers	Clerical	Management
1.0	5.9	14.0	4.3	6.6	5.1	15.3	1.8	20.6	10.8	15.6
2.0	18.8	11.9	2.9	8.4	6.6	16.1	3.5	18.9	3.5	9.5
3.0	18.0	17.6	4.3	6.7	5.6	13.4	8.6	16.8	4.1	4.8
4.0	16.9	15.5	3.7	3.7	13.2	13.2	12.1	14.9	3.7	3.1
8.0	22.3	2.4	2.4	2.7	11.5	7.3	9.2	16.7	9.4	16.0
9.1	6.2	7.1	.2	18.0	8.9	11.7	5.6	22.2	7.8	12.5
9.2	10.3	12.2	2.9	5.1	9.1	20.3	4.7	10.6	7.0	17.8
9.3	11.0	3.4	3.1	3.9	13.8	23.1	7.3	17.1	5.1	12.0
9.4	14.8	12.1	5.6	5.7	13.0	15.5	6.3	13.8	3.8	9.4
10.1	11.4	8.1	2.8	6.0	8.9	24.6	6.6	19.6	4.1	7.8
10.2	25.8	6.8	4.3	8.0	10.6	12.8	7.2	14.4	4.0	6.0
10.3	17.6	5.4	2.8	9.3	16.5	12.4	5.8	14.5	5.4	10.3
11.1	5.5	12.5	.0	18.8	3.6	20.2	3.9	18.8	5.4	11.4
11.2	9.2	13.2	3.5	7.8	9.3	15.5	6.4	25.6	3.1	6.5
11.3	8.5	2.0	2.3	11.3	17.4	18.7	3.3	15.6	5.6	15.4
11.4	24.4	1.9	.0	4.7	18.5	8.7	8.7	11.8	2.9	18.5
12.1	5.1	1.5	.0	18.9	3.1	7.7	8.4	35.5	8.4	11.5
12.2	9.2	10.9	.2	10.0	5.1	20.4	1.3	24.3	6.5	12.2
12.3	13.3	8.8	1.4	6.1	11.1	19.2	5.8	17.0	4.8	12.5
12.4	21.4	6.3	2.0	6.3	17.5	10.5	7.8	14.4	3.7	10.2
13.1	8.1	7.9	.6	29.7	3.8	7.7	8.2	15.4	5.2	13.4
13.2	7.8	6.4	.1	25.5	6.8	7.9	6.5	22.5	5.2	11.2
13.3	9.7	11.1	1.3	23.5	5.3	8.4	4.7	16.8	5.8	13.3
13.4	9.7	12.5	1.8	18.8	5.2	9.2	4.2	17.9	5.7	15.0

variables which capture both the availability of labor in the area and the relative attractiveness of employment opportunities at the construction project. These factors typically have not been considered in empirical studies of this nature.

Relocation of Dependents

Another important issue in the estimation of construction-related impacts involves movers' decisions regarding the relocation of their families. The presence or absence of a family influences community impacts in several ways. In particular, household composition and family size influence the types of housing, consumer goods, and public services demanded by movers.

The variation in the proportion of movers with family present -- both overall and for various worker groups -- is presented in Table 4. We observed a very pronounced regional variation with respect to the relocation of dependents, with the proportions of movers with family being much higher in the South than in the North. Overall proportions of movers with family present typically ranged from 52 to 53 percent in the North compared with 58 to 74 percent in the South. This pattern was apparent overall, as well as for various worker groups.

We also observed differences in the relocation of dependents among various worker groups. Nonconstruction movers were much more likely to relocate families than were construction movers. Among nonconstruction movers, the proportion of movers with family present typically ranged from 64 to 76 percent in the North and from 70 to 85 percent in the South, whereas among the construction group proportions typically ranged from 46 to 54 percent in the North and from 51 to 59 percent in the South. In examining differences between the scarce craft group and the common and abundant craft group, we observed a significant difference in the case of the northern sites. Typically, proportions ranged from 41 to 48 percent for the scarce craft group compared with 51 to 56 percent for the common and abundant craft group. However, a similar pattern was not observed in the case of the southern sites.

The likely explanations for the differences between worker groups with respect to the relocation of dependents lie in the differences in employment opportunities for various worker groups. In the case of the nonconstruction group, movers consist primarily of management rather than clerical workers. These workers are often hired by the utility or prime contractor for the duration of the project. Thus, while their tenure at the site is limited, it is not necessarily short. Employment at the site is quite stable and could extend for a period of up to ten years. In addition, the employment contracts of management workers are likely to cover the cost of moving their families. The situation,

TABLE 4. VARIATION IN THE PROPORTION OF MOVERS WITH FAMILY PRESENT BY REGION, OVERALL AND FOR VARIOUS WORKER GROUPS a/

	Migrant Proportion	
	Absolute Range	Typical Values
Overall		
North	51-53	52-53
South	51-86	58-74
Construction		
North	35-54	46-54
South	44-85	51-69
Nonconstruction		
North	52-76	64-76
South	50-87	70-85
Scarce		
North	25-48	41-48
South	53-83	53-69
Common and Abundant		
North	51-64	51-56
South	40-89	49-69

a/ Movers without families include single movers as well as married movers who do not relocate their families.

however, is quite different in the case of the construction group. Because of the more limited duration of employment opportunities at the site for construction workers, they are less likely to relocate their families. This is most obvious in the case of the scarce craft group.

The reasons for the regional difference with respect to the relocation of dependents are not readily apparent. However, several factors have been identified which could contribute to the explanation of this difference. For instance, our data indicated that a relatively higher proportion of movers was married in the South than in the North -- approximately 75 percent in the North compared with approximately 85 percent in the South. The observed variation in the relocation of dependents could also be related to regional differences in the housing type chosen by movers. In our analysis of housing type, we observed a much higher proportion of movers living in mobile homes in the South than in the North -- approximately 20 percent in the North compared with approximately 40 percent in the South.

Thus, we observed a rather large variation in the proportion of movers with family present among the surveys included in our study. In most cases, the proportion of movers with family present was relatively large (ranging from 45 to 70 percent among construction movers and from 65 to 85 percent among nonconstruction movers). Since the proportion of movers who relocate their families has an influence upon a number of important impacts (i.e., housing requirements, school enrollments, other service demands), it follows that careful consideration should be given to this factor in socioeconomic impact assessment.

The large variation in the relocation of dependents which has been observed across sites, as well as across various worker groups, has identified a clear need to develop improved forecasting procedures. However, our analysis has shown that the observed variation in the proportion of movers with family present is a function of several factors. In addition to certain labor requirement variables (variables which reflect differences in the expected duration and continuity of employment at a site), these factors might include differences in marital status, availability of different types of housing, and the quality of schools and other services in nearby communities. An adequate explanation of the observed variation would, therefore, require a multivariate analysis. An examination of the data included in this study suggests that such an analysis is likely to provide a means of improving the accuracy of predicting the proportion of movers who will relocate their families at future construction sites, thereby improving the general accuracy of the impact assessments.

Intention to Remain in the Area

Some workers will move to the area to work on the project with the intention of remaining in the area after employment opportunities at the project have been exhausted. Other workers will move to the area to seek employment while it is available, or perhaps for shorter durations. It is likely that these subgroups of movers will differ in their utilization of goods and services. For instance, movers who expect to remain in the area for a short period of time are likely to seek temporary housing (i.e., apartments, mobile homes, hotels/motels) and may or may not relocate their families. A certain number of such workers may live in the area only during the workweek, returning to a permanent residence on weekends.

Recognition of these differences raises questions of (1) whether or not a significant number of movers at a site consider their move to be temporary, and (2) whether or not the size of this group varies from site to site. Answers to these questions are used as a means of determining the importance of considering intention to remain in estimating socioeconomic impacts.

Table 5 presents the variation in intention to remain in the area, overall and for various worker groups, for those surveys for which information on intention to remain was available. 7/ In general, more than half (50 to 59 percent) of all movers were classified as temporary movers (movers who intended to leave the area either before or on completion of the project).

As was true with respect to migrant proportion and relocation of dependents, we also observed differences with respect to intention to remain in the area for various worker groups. Most pronounced were the differences between the construction and nonconstruction groups. Among the construction group, only 41 to 49 percent of the movers were classified as temporary movers, whereas, among the nonconstruction group, 59 to 74 percent of movers were considered to be temporary. The rather limited number of movers in certain subgroups of workers (i.e., the clerical and abundant categories) limited the comparisons which could be made by further disaggregating the construction and nonconstruction groups. However, our analysis did indicate that scarce movers were less likely to remain in the area upon completion of the project than were movers in the common and abundant group. The

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7/ Temporary mover proportions were based on information from only four surveys, while information on the proportion of movers with a permanent residence elsewhere was available for seven surveys.

TABLE 5. VARIATION IN INTENTION TO REMAIN IN THE AREA, OVERALL AND FOR VARIOUS WORKER GROUPS

	Temporary Mover Proportion	Transient Mover Proportion	Proportion of Movers with Permanent Residence	Worksheet Mover Proportion
Overall	50-59	8-18	34-45	15-28
Construction	41-49	8-18	40-59	15-37
Nonconstruction	59-74	10-21	7-24	2-11
Scarce	45-56	8-17	39-68	14-45
Common and Abundant	27-49	7-18	24-49	15-29

proportion of movers who were temporary typically ranged from 45 to 56 percent for the scarce crafts compared with 27 to 49 percent for the common and abundant crafts.

As an alternative measure of intention to remain, we examined the proportion of movers who maintain a permanent residence elsewhere. These proportions were similar to the proportions of movers who were considered to be temporary among construction movers (40 to 59 percent). However, the use of a permanent residence as an indication of intention to remain was not appropriate in the case of the nonconstruction group.

In an attempt to identify those movers who moved to the area for a much shorter duration, we examined two other subgroups of movers -- transient movers 8/, and workweek movers. 9/ Approximately 10 to 20 percent of movers among both construction and nonconstruction movers moved into the area for specific jobs and did not stay in the area for the entire construction period. Typically, 15 to 28 percent of all movers lived in the area only during the workweek, with workweek movers proportions being higher among construction movers (15 to 37 percent) than among nonconstruction movers (2 to 11 percent).

Again, these observed differences in intention to remain in the area are not surprising given the differences in employment opportunities among the various worker groups. Most nonconstruction movers consist of management rather than clerical workers. These workers typically are transferred upon completion of the project. Furthermore, the long-term employment potential for these workers in this area (especially a rural area) is rather limited. As a reflection of these factors, we did observe that most nonconstruction movers expect to leave the area upon completion of the project.

In the case of construction workers, the nature of employment opportunities, both at the site and in the area after completion of the project, differ considerably from those experienced by nonconstruction workers. Construction workers may be more likely than nonconstruction workers to find employment in the area after completion of the project. As a reflection of this, we did observe lower proportions of temporary movers among the construction group.

8/ Transient movers are a subset of temporary movers. Transient movers are those workers who move into the area for short durations irrespective of the availability of continued employment at the site.

9/ Workweek movers are a subgroup of movers who maintain permanent residences elsewhere. These workers live in the area during the workweek and return to their permanent residences on weekends.

Furthermore, we observed that a relatively large proportion of construction movers maintain permanent residences elsewhere. This is also consistent with the nature of employment in the construction industry. The construction industry is characterized by a high labor turnover. Employment for construction workers is seldom permanent. Rather, workers are hired for specific jobs of a limited duration. As a result, it is often necessary for construction workers to move from site to site or to commute rather long distances each day to maintain steady employment. Because of the temporary nature of employment opportunities, many workers maintain permanent residences, live in temporary housing near the construction site during the workweek, and return to their permanent residences on weekends.

Intention to remain in the area is important to socioeconomic impact assessment only to the extent that the bundle of goods and services consumed by temporary movers differs from the goods and services consumed by permanent movers. However, the major difference in the consumption patterns between these two groups is likely to stem from differences in the relocation of dependents. Examination of our data did indicate that permanent movers are more likely to relocate their families than are temporary movers (the proportion of movers with family present typically ranged from 50 to 60 percent among temporary movers compared with 65 to 75 percent among permanent movers). [10] However, this difference between permanent and temporary movers was not as large as one might have expected. This difference can, in part, be attributed to the nonconstruction group. Despite the fact that the vast majority of nonconstruction movers regard their move as temporary, most nonconstruction movers relocate their families. Moreover, while employment opportunities for construction workers at nuclear power plant construction sites may be of limited duration, they are not necessarily short. Indeed, employment for some worker groups may extend for a period of 5 years or more. Therefore, there may be little justification for distinguishing between temporary and permanent movers for the purpose of socioeconomic impact assessment.

Transient movers and workweek movers, on the other hand, are more likely to exhibit different consumption patterns from those of other movers. Thus, it might be argued that these groups are worthy of special consideration in impact assessment. However, in most cases, these two groups constitute a fairly small proportion of all movers. In terms of absolute numbers, it is likely that transient movers and workweek movers would constitute a large group only at a site with a large total workforce and high migrant proportion. The results of this analysis, therefore, suggest that in most cases a consideration of intention to remain will not greatly improve the accuracy of socioeconomic impact assessments.

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[10] These figures may appear low for permanent movers. However, one will recall that the group of movers who did not relocate their families included single movers as well as married movers who did not relocate their families.

Demographic Characteristics of Movers

There was little variation in most demographic characteristics of movers across sites and surveys (Table 6). However, we did observe an interesting regional difference with respect to marital status. This difference was observed among the construction group -- with over 85 percent of movers being married in the South compared with 75 percent in the North. No regional difference, however, was apparent among the nonconstruction group.

Family size varied somewhat across the various worker groups. The average family size of construction movers (3.4) was somewhat higher than that of nonconstruction movers (3.1). This difference was also reflected in the average number of school-age children. Averages were higher among construction movers (0.9) than among nonconstruction movers (0.7).

Information on income was available for only four surveys, and as a result, the conclusions drawn on the basis of these data were somewhat limited. However, a few general patterns were apparent. The overall median income among movers was approximately $21,000 a year, with the average among the nonconstruction ($21,700) group being higher than among the construction group ($20,500). This, of course, reflects the higher average salaries of the management subgroup, which dominates the nonconstruction mover group. Similarly, it is not surprising to note that the median family income among the scarce movers ($21,000) was higher than that among the common and abundant mover group ($19,300). This undoubtedly reflects the more specialized skills of craft which comprise the scarce craft group.

The relatively small variations which we observed in most mover characteristics would tend to imply that survey results (with only a few modifications to account for the special characteristics of the site in question) can quite safely be used for forecasting mover characteristics at future construction sites. These data could be used to derive multipliers which, in turn, could be used to estimate total family size (or perhaps number of school-age children) associated with an inmigrating construction workforce.

TABLE 6. AVERAGE MOVER CHARACTERISTICS, OVERALL AND FOR VARIOUS WORKER GROUPS a/

	Percent Married	Average Family Size	Average Number of School-Age Children	Median Family Income b/
Overall				
North	74.7 (4.9)	3.26 (.15)	.81 (.16)	21,000 (1,143)
South	85.1 (3.4)			
Construction				
North	74.8 (4.0)	3.39 (.14)	.90 (.16)	20,500 (1,365)
South	86.7 (4.0)			
Nonconstruction				
North	75.9 (10.8)	3.10 (.16)	.67 (.16)	21,700 (1,503)
South	76.0 (4.6)			
Scarce				
North	74.4 (7.4)	3.42 (.20)	.94 (.24)	21,000 (1,444)
South	85.9 (4.4)			
Common and Abundant				
North	75.4 (5.4)	3.35 (.16)	.89 (.18)	19,300 (741)
South	87.5 (3.9)			

a/ Mean values with standard deviation in parentheses.
b/ Incomes are in 1978 dollars.

IMPLICATIONS FOR MODEL DEVELOPMENT

In our discussion of the results of this analysis, we highlighted several implications with respect to impact assessment and the development of improved forecasting procedures. Implications specific to each of the four variables -- migrant proportions, relocation of dependents, intention to remain in the area and demographic characteristics of the movers -- were discussed individually in each section. In this concluding section, we focus on the more general implications of these findings for model development.

Foremost, in our examination of these data, we observed a large variation in both overall migrant proportion and the relocation of dependents across sites. This suggests that the practice of making forecasts at one site based solely upon the observed values at another site (or even the average across several sites) can be a dangerous practice. In addition, our examination clearly highlights the need for a multivariate analysis to improve our understanding of the factors underlying the variation in these variables across sites as a necessary first step in the development of improved forecasting procedures. The results of this analysis indicate that workforce composition, the availability of labor in the area and the nature of labor requirements could be important factors in explaining the observed variation in these variables across sites.

A second major finding of this analysis is that one also observes considerable variation in migrant proportion and relocation of dependents among different workers groups. This suggests that occupation may be an important dimension in examining these issues. The importance of this finding is that it allows one to perform a multivariate analysis using craft-specific worker groups as the unit of analysis.

Past studies of this nature have been limited by the availability of data. Construction worker survey data are difficult to obtain and, as a result, data are not available for a large number of sites. Indeed, past studies have often been limited to at most 14 sites. If the site is used as the unit of analysis, the data do not provide a sufficient number of observations to conduct a multivariate analysis. However, the results of our examination indicate that it is possible to identify 7 or 8 major craft groups with sufficient numbers of workers in each craft group to examine variation with respect to each craft group at each site. Adopting this approach provides a sufficient number of observations for a multivariate analysis, thereby overcoming the data limitations which have hindered past studies of a similar nature.

An additional advantage of using craft as the unit of analysis stems from the fact that labor requirements are craft-specific. Thus, it will be possible to consider the importance of a number of craft-specific labor requirement variables such as income potential associated with employment at the site, labor requirements for project construction, local availability of labor and competing demand for labor for each craft group, in addition to the importance of regional and project characteristics, in explaining the observed variation across sites and crafts.

Another rather interesting finding is the very pronounced difference with respect to both migrant proportion and relocation of dependents which was observed between construction and nonconstruction workers. In most cases, however, this variation was seen to reflect basic differences in the nature of employment opportunities between the two groups at construction sites. This suggests that the factors underlying such relocation decisions are not the same for these two worker groups. The implication of this for purposes of model development is simply that a separate model should be developed for each group. Combining these two very different groups in the same model is likely to result in a reduction in the overall predictive power of the model.

Adopting a craft-specific approach to model development requires that an accurate estimate of craft-specific labor requirements be available prior to project construction. Accurate estimates of labor requirements are necessary in the development of forecasting procedures, as well as in the application of these models for estimating impacts at future construction projects. Our study, however, has indicated that in most cases pre-construction projections provided by utilities are poor indications of the actual utilization of labor. Improvements in this regard are critical to improvements in impact assessment, because even the best forecasting procedures will fail to perform well if they are based upon inaccurate estimates of manpower requirements.

In conclusion, our examination of migrant proportion and relocation of dependents has identified considerable variation across sites and across different worker groups. These findings imply the need for a craft-specific multivariate analysis as a possible means of improving forecasting procedures. A consideration of intention to remain in the area, except perhaps in very special instances, is not extremely important in making socioeconomic impact assessments. Demographic characteristics of the movers are quite invariant across sites. They are, therefore, amenable to the development of multipliers that can be readily employed to make impact assessments after the migrant proportions and proportions of workers who will relocate families have been estimated.

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AN ANALYSIS OF THE AGRICULTURAL HIRED LABOR MARKET FOR THE NORTHERN GREAT PLAINS WITH EMPHASIS ON THE EFFECTS OF ENERGY DEVELOPMENT

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Richard A. Adams [1]

INTRODUCTION

Residents of the Northern Great Plains (defined as Montana, North Dakota and Wyoming) have expressed concern over adverse consequences of the rapid development of the mining sector in the region. Environmental, social and economic effects are of particular interest to affected parties, as well as to researchers and public policy makers. This interest has been manifested in numerous studies related to the environmental and socioeconomic effects of energy [2] development on cities and towns in affected areas (Bradley *et al.*, 1979; Leistritz, 1973; Northern Great Plains Resources Program, 1975). However, there is a scarcity of information concerning the effects of growth in the mining sector on agricultural factor markets.

Numerous effects of increased mining activity on farmers and ranchers may be identified. Among the more important is the potential competition for factors of production (Leistritz, 1973). Land and water are two obvious factors for which the mining and agricultural sectors compete. Another factor market being affected by energy development is labor, where wages have risen sharply in energy. A survey by Conklin (1977) of selected livestock producers within an energy-impacted region of Wyoming (Powder River Basin) reveals concern among such producers over the ability to pay wages competitive with those realized in mining. While differences in agricultural and mining wages have persisted over time, the recent rapid expansion of mining employment has increased the magnitude of the difference. Even in the absence of a closed economy, a large wage difference may create an incentive to transfer between sectors.

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[2] The terms "energy" and "mining" are used interchangeably in this study to refer to the aggregate of coal, oil, natural gas and uranium extraction.

This paper investigates the nature of the market for hired agricultural labor for the Northern Great Plains, with particular reference to adjustments that may be attendant to energy development. Specific objectives include: 1) review alternative model specifications and specify a labor market model which defines the structure for hired agricultural labor for the Northern Great Plains; 2) assess the importance of wages in agriculture and mining in explaining the structure of hired labor to agriculture in the Northern Great Plains, with emphasis on the plausibility of mining wages as an incentive for the transfer of labor out of agriculture, as suggested by affected parties in the region; and 3) compare the results with earlier regional supply and demand studies. The focus is directed toward measuring the impact of energy development on a particular segment of the economy in the impacted region as reflected in a particular factor market, labor. Emphasis is on understanding the causal relationship within that factor market and on examining the structure which generates the data observed at the macro or aggregate level.

THE PROBLEM SETTING

There is a scarcity of published elasticity measures available at the regional level. Adjustments at the regional level, such as the Northern Great Plains, may indeed be more substantial than national developments. Specifically, the rural nature of the Northern Great Plains, when coupled with the imposition of a growth sector of the magnitude of energy, suggests a need to estimate the (changing) structural relationships in the hired labor market at the regional level.

To demonstrate the growth of the mining sector within the Northern Great Plains, evidence gathered from the three-state region of Montana, North Dakota and Wyoming is presented in Table 1 for the period 1964-78. Employment data for agriculture and mining as well as wage rates are presented. As is evident from the table, the out-migration of hired workers from agriculture continues (1978 is the exception) but the rate appears to have slowed. During this same 15 year period, mining employment within the three state region has more than doubled, with particularly rapid increases in the last three years. Wage rates

TABLE 1. AGRICULTURAL AND MINING EMPLOYMENT AND WAGES IN THE NORTHERN GREAT PLAINS a/, 1964-1978

	Employment		Wage		
Year	Agriculture	Mining	Agriculture	Mining	Difference
	- Number -		- dollars per hour -		
1964	42,000	17,900	1.26	2.97	1.71
1965	31,000	18,000	1.27	3.06	1.79
1966	32,000	18,300	1.37	3.18	1.81
1967	31,000	16,900	1.40	3.29	1.89
1968	27,000	18,100	1.51	3.41	1.90
1969	26,000	19,500	1.63	3.63	2.00
1970	26,000	19,700	1.68	3.87	2.19
1971	28,000	18,100	1.80	4.03	2.23
1972	27,000	20,000	1.93	4.46	2.53
1973	27,000	20,400	2.14	4.75	2.61
1974	29,300	25,000	2.42	5.49	3.07
1975	26,000	26,500	2.65	6.16	3.51
1976	25,300	30,000	2.90	6.80	3.90
1977	21,300	34,800	3.08	7.91	4.83
1978	23,200	40,000	3.46	9.65	6.19

a/ Data for North Dakota, Montana and Wyoming.

Sources: U.S. Department of Agriculture; Agricultural Statistics and U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings.

have increased in both sectors, but mining wages increase at a more rapid rate, as measured by the differences in wages.

This descriptive evidence may serve to lend plausibility to the assertion by agricultural interests that growth in the energy industry with attendant multiplier effects as manifested in the service sectors is accelerating the transfer of labor from agriculture. Associated adjustment problems may be particularly acute in areas immediately surrounding energy development, given that the economic base in many of the rural areas in which energy expansion is occurring is relatively simple and is historically dominated by the agricultural (livestock) sector. The Powder River Basin of Wyoming, the principal coal production area in the Northern Great Plains, is typical of the economic structure of much of the Northern Great Plains area: livestock oriented with no industrial base other than energy.

The following section outlines conceptual models for hired agricultural labor for the Northern Great Plains based upon theoretical constructs outlined by Magee and Borts and upon the formulation developed by Schuh (1962), Schuh and Leeds (1963), and Tyrchniewicz and Schuh (1966) and adopted by Hammonds, et al. (1973). Modifications intended to examine the specific importance of energy development in the Northern Great Plains are also discussed. A discussion of data problems, a statistical model and estimated relationships are then presented.

THE MODEL

At least two approaches may be taken in analyzing the impacts of energy development on agricultural hired labor. These include: 1) model the wage difference and attempt to determine factors which are are important in explaining the wage difference, and 2) model the agricultural hired labor system incorporating a measure which reflects the growth in the mining sector.

The relationship between agricultural employment and wage differences (across agriculture and alternative employment) is hypothesized to be an important aspect of agricultural labor supply (Tyrchniewicz and Schuh, 1966). That is, the magnitude of the difference in factor returns affects the ultimate labor supply to agriculture. This suggests that current energy development patterns in the three-state region and other rural states which continue to alter the rate of return across rural economic sectors may affect agricultural employment levels and wages.

The existence of a substantial wage difference between the agricultural and mining sectors in the Northern Great Plains may be explained by general equilibrium theory related to factor market distortions and factor price differentials (Magee, 1976 and Borts, 1960). As noted, the wage difference itself is a measure of the difference in the returns to a factor (labor) in the agricultural and mining industries. This may be brought about by market imperfections or distortions. Following Magee (1976), distortions in the agricultural and mining labor market may include:

(1) "monopoly" power of firms within the mining sector, enabling them to share monopoly profits with labor;

(2) union pressure on wages in the mining sector, both direct (where unions exist), and indirect (where management seeks to avoid labor disruptions by meeting or exceeding union wages); and

(3) disguised unemployment in agriculture (e.g., a hired man is retained year-round although his services may not be fully utilized in the off seasons).

The existence and significance of these trends concerning factor market distortions may also be viewed within the conceptual framework presented by Borts (1960). Differences in returns to factors of production, such as labor, may be explained by relative changes in final demand experienced by each industry. Thus, the two prominent rural industries within the Northern Great Plains may be viewed as competing for the same input, labor. However, one industry (agriculture) has been characterized by a relatively constant demand, while the other is experiencing rapid growth. Such a situation then results in a differential in the rate of return to the factor of production as manifested in the disequilibrium in wage rates currently being observed.

Other causes, which may be termed non-distortionary, may also be responsible for the observed wage difference between mining and agriculture. These include: 1) transfer costs associated with moving from agriculture to mining employment; 2) a preference on the part of some agricultural labor to remain employed in agriculture; and 3) perquisites which may be included in the agricultural wage package but not reflected in the agricultural wage rate.

A model incorporating these constructs has been presented by Conklin, et al. (1978). Data are difficult to obtain for a time series of sufficient length of conduct empirical analyses with respect to

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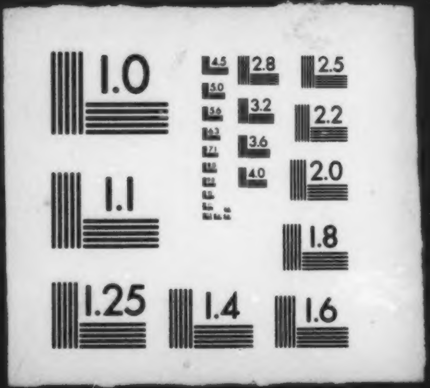

distortionary effects. Therefore, while appearing to be promising from a theoretical standpoint, little empirical evidence is available which proves or disproves the usefulness of a model using the above framework to explain wage differences between mining and agriculture.

The second approach, pursued in this paper and reported by Adams and Menkhaus (1980), follows that developed by Schuh (1962), Tyrchniewicz and Schuh (1966) and Hammonds, et al. (1973) with minor deviations to address the influence of the mining sector on agricultural hired labor. Specifically, the growth of the mining sector, as a basic sector within the context of a regional economy, is assumed to generate substantial economic activity within the region. The resultant economic growth, particularly as manifested in rising wages, may affect the agricultural labor market, even in the absence of direct substitution between mining and agricultural employment. Within this model, the quantity of hired labor demanded is assumed to be a function of the real agricultural hired labor wage, index of prices received by farmers deflated by the index of prices paid by farmers, and an index of productivity (technology). The quantity of hired labor available (supplied) to agriculture is hypothesized to be a function of the real agricultural hired labor wage, the regional civilian labor force, real mining wage [3] and a trend variable. Consistent with the Schuh (1962) formulation, each equation in each model is specified in the Nerlovian framework to facilitate estimation of both long-run and short-run elasticities. The empirical content of this model appears to be somewhat stronger compared to the former approach. Specifically, data are available and the model is theoretically sound.

THE STATISTICAL MODEL

A statistical model for the regional labor market incorporating the Schuh-Hammonds framework may be summarized in the following two equations:

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[3] This variable represents a deviation from the models developed by Schuh and his associates (1962, 1963, 1966). Schuh used "corrected" non-farm income to represent alternative employment opportunities. Since the main emphasis of this study is on the impacts of the mining sector on agricultural hired labor, alternative income opportunities are represented by the mining wage.

$$(1)\quad Y_{1t} = \beta_0 + \beta_1 Y_{2t} + \beta_2 X_{1t} + \beta_3 X_{2t} + \beta_4 Y_{1t-1} + \mu_{1t}$$

$$(2)\quad Y_{1t} = \alpha_0 + \alpha_1 Y_{2t} + \alpha_2 X_{3t} + \alpha_3 X_{4t} + \alpha_4 X_{5t} + \alpha_5 Y_{1t-1} + \mu_{2t}$$

where: Y's = endogenous variable;
X's = exogenous variables'
Y_{1t} = agricultural hired labor force for Montana, North Dakota and Wyoming in year t in thousands (U.S. Department of Agriculture);
Y_{2t} = average hourly agricultural wage in year t deflated by the Consumer Price Index (1967=100) for the three state region (U.S. Department of Agriculture);
X_{1t} = ratio of the index of prices received over the index of prices paid by U.S. farmers in year t (U.S. Department of Agriculture, n.d.);
X_{2t} = farm productivity index of output per unit of input, for the Northern Great Plains in year t (U.S. Department of Agriculture, 1977);
X_{3t} = average of Montana, North Dakota and Wyoming hourly mining wage in year t deflated by the Consumer Price Index (U.S. Department of Labor 1977 and 1979);
X_{4t} = the first difference of the civilian labor force in Montana, North Dakota and Wyoming in ten thousands in year t (U.S. Department of Commerce, n.d.);
X_{5t} = time trend variable;
μ_{1t} and μ_{2t} = random disturbances;
α's and β's = structural parameters;
β_4 = $1 - \gamma_1$, where γ_1 = the coefficient of adjustment for demand;
α_4 = $1 - \gamma_2$, where γ_2 = the coefficient of adjustment for supply;
t = 1964-1978.

DATA

The data for agriculture and mining wages for the region are represented by those observed in Montana, North Dakota and Wyoming. The selection of this three state region is motivated by the significant position this region has assumed in national coal production. Consistent with the Schuh and Hammonds, et al. (1962, 1963, 1966) formulations, wage data are deflated.

In the model, agricultural employment represents the hired farm labor force in Montana, North Dakota and Wyoming, which are the states most affected by energy development in the Northern Great Plains. Similarly, the civilian labor force includes non-agricultural employees in the three state region. Finally, national data for prices received and paid by farmers are used to represent the income to farming and ranching in the region. Data were collected for 1964-1978, the period encompassing the expansion of energy development in the Northern Great Plains region.

STATISTICAL CONSIDERATIONS

There are problems attendant to empirical application of the above model, especially with time series data. Griliches (1961) suggests that the use of a lagged independent variable leads to serial correlation in the error term. Serial correlation of the error term then leads to inconsistent parameter estimates in autoregressive models (Griliches, 1967). The traditional Durbin-Watson statistic is also invalid in such models. Durbin (1970) has addressed this latter issue, but the problem of inconsistent parameter estimates must still be faced if the neo-Durbin test reveals the existence of serial correlation among the residuals.

An approach to handling serial correlation is to assume the existence of serial correlation and adjust for its presence, using an appropriate estimation procedure (Johnson, 1961). One method for calculating regression parameters in the presence of first order autoregressive disturbances is the Cochrane-Orcutt iterative technique. Fair offers further input into the estimation of simultaneous equation models with lagged endogenous variables and first order serially correlated errors, such as the model assumed here. More specifically, Fair suggests care must be taken in forming the instrumental variables in two-stage least squares regressions. To arrive at consistent estimates, predetermined variables, predetermined variables lagged once, endogenous variables lagged once, and the dependent variables lagged once must be included as first state predetermined variables (Fair, 1970, p. 508).

The Cochrane-Orcutt iterative technique, incorporating the suggestions by Fair, was employed to estimate the economic model. The computer program which includes the software to handle this estimation procedure is available through Synergy, Inc.

Another statistical problem in Nerlovian-type models is that the lagged dependent variable has a tendency to pick up the effect of omitted variables, thus leading to problems of specification bias. Usually, this problem is handled in part by introducing a trend variable into the statistical model (Schuh, 1962, p. 313; Hammonds, et al., 1973, p. 245). Unfortunately, the introduction of such a variable compounds the already severe collinearity problems associated with models of this type. High intercorrelation among the independent variables was observed by Tyrchniewicz and Schuh (1966, p.547) and Hammonds, et al. (1973, p. 245). The authors of the latter study removed the trend variable in the demand equation where there was high collinearity between the trend variable and the productivity index. Further, Schuh and Leeds (1963, p. 301) found that the trend variable was significantly different from zero at the 5 percent level in only two of nine regions in their study of the regional demand for hired agricultural labor. Schuh (1962, p. 312) found the trend variable in the demand equation to be insignificant. In the model outlined above, high intercorrelation (.98) exists between the trend variable and the real agricultural wage, which appears in both the supply and demand equations. As a result of this high interdependence between the trend variable and real agricultural wage and supported by results of previous studies, the trend variable was not included in the demand equation. As a result of omitting a trend variable, caution should be exercised in interpreting the direct price elasticities obtained from the estimated demand relationship due to possible specification bias.

The omission of the trend variable from the demand equation may not be particularly serious from an economic standpoint, since the productivity index variable included in the demand equation should be measuring the influence of technology. However, in the supply equation the inclusion of a trend variable is deemed important in terms of explaining the secular movement in the flow of labor out of agriculture due to changes in tastes for employment in specific industries, aspects of industrialization and the level of education (Tyrchniewicz and Schuh, 1966, p. 542 and 551). Even though collinearity exists between trend and the real agricultural wage, there appears to be theoretical justification to retain the trend variable in the supply equation.

High collinearity also exists between the civilian labor force and real agricultural and mining wage, .97 and .95, respectively. Following Kmenta (1971, p. 390), the civilian labor force and nonfarm income data were transformed to first differences to reduce collinearity. While this transformation reduces the degree of multicollinearity, it introduces autoregression in the disturbances, which may otherwise be independent. It was felt the use of the first difference transformation was preferable to omitting a variable whose inclusion was again justified on theoretical grounds, since the estimation procedure adjusts for serial correlation.

RESULTS AND IMPLICATIONS

The model estimated and reported here may be viewed as dynamic given the presence of distributed lags. The model thus allows for the estimation of both short- and long-run structural relationships via the use of the coefficient of adjustment. Alternative formulations of the model were tested, most notably a log-log version. The reported model (linear) was deemed "better" due to slightly more robust statistical estimates. In addition, there is no reason to believe that the assumption of constant elasticities is valid.

A priori expectations concerning the signs of the variables included in the above model are suggested by theory. One may hypothesize that the quantity demanded is inversely related to the labor wage and the productivity index, and directly related to the price indices ratio and the lagged value of the dependent variable. Quantity supplied is expected to be directly related to the agricultural wage and the civilian labor force, and inversely related to the "corrected" non-farm income, mining wage and trend. The simultaneously estimated regression coefficients for the above economic model are presented in Table 2. The results appear to be generally consistent with those expectations.

The statistical results for the demand equations are more robust than for the supply relationships, as is evident from Table 2. Specifically, the agricultural wage, the price indices ratio and the lagged dependent variable are significant at the 5 percent level and display signs consistent with expectations except for the productivity index. Also, the R^2's associated with the demand equations are greater than those observed for the supply relationships. (The R^2 in both equations may be artificially inflated due to the presence of the lagged dependent variable.) On the supply side, the results are less robust but do display general consistency of signs. Only the change in the regional civilian labor force, which is insignificant at the 10 percent level, displays an incorrect sign. The regional agricultural wage and the mining wage are significant at the 10 percent level, with the time trend being significant at the 5 percent level.

The significance of several variables bears closer examination in terms of economic implications. Within the demand equations, the

TABLE 2. SIMULTANEOUS EQUATION REGRESSION COEFFICIENTS FOR THE NORTHERN GREAT PLAINS, 1964-1978

Equation	Constant	Agricultural Wage	Prices Received Prices Paid	Productivity Index	Y_{1t-1}	Mining Wage	Change in Civilian Labor Force	Time Trend	Summary Statistics[1/]		
									R^2	F	Rho
Demand	8.52	-13.84**	0.25**	0.08	0.26**	--	--	--	0.89	18.05	-0.49
	(1.01)	(-4.73)	(4.65)	(1.69)	(2.73)						
Supply	66.21	56.04*	--	--	0.05	-3.26*	-1.32	-1.58**	0.72	4.24**	0.19
	(1.35)	(1.64)			(0.28)	(-1.43)	(-0.45)	(-2.32)			

*Significantly different from zero at the 10% level; figures in parentheses are t values.

**Significantly different from zero at the 5% level; figures in parentheses are t values.

[1/] The t, R^2 and F values are not strictly valid for the second stage of TSLS since they are based on estimates instead of actual values of endogenous variables. In addition, the t statistics are biased upward due to the use of the Cochrane-Orcutt iterative techinque (Cooper). Since the Cochrane-Orcutt procedure was used to adjust for assumed serial correlation, the value of Rho is reported rather than the Durbin-Watson statistic.

Source: Adams and Menkhaus

lagged dependent variable (and resultant coefficient of adjustment) are significant, which indicates that substantial adjustments are occurring within the regional agricultural hired labor market and conforms to the distributed lag hypothesis. However, the lagged dependent variable in the supply equation, while having the correct sign, is not significant, an observation consistent with Hammonds, *et al.* Also, the significance of the mining wage (10 percent) within the supply equation provides some support to the hypothesized importance of this variable in the agricultural labor market. The implication of this relationship is that continued change in the mining wage does appear to have an effect on the supply of labor to agriculture in this region. Within a regional context, the significance of the trend variable lends support to Tyrchniewicz and Schuh's assertion that this variable may be an important shifter of the supply of labor to agriculture; that is, the supply of hired agricultural labor may be influenced by factors such as tastes, education and industrial structure, in addition to traditional economic variables. The trend variable may also be capturing the effects of consistent measurement error in some of the variables (Tyrchniewicz and Schuh, 1966, p. 551).

Based upon the estimated structural relationships presented in Table 2, short- and long-run supply and demand elasticities were calculated (Table 3). Specifically, demand elasticities were calculated with respect to the regional agricultural hired labor wage at mean levels and for 1978 to investigate any shifts in the underlying relationship. For the supply equation, elasticities with respect to agricultural wage as well as the mining wage were derived.

The regional demand elasticity (Table 3) for 1978 was approximately 30 percent greater than that calculated at the mean level (-0.76 as compared to -1.06). The long-run elasticities increased over short-run values within periods as well as between mean and 1978 levels, i.e., the long-run elasticities are approximately 40 percent greater in 1978 than for the mean. Comparing these elasticities with those reported by Schuh and Leeds (1963) for the Mountain States and Hammonds *et al.* (1973) for Oregon, the absolute levels observed fall within the range observed in these earlier studies; i.e. that is, higher than those for Schuh and Leeds but lower than those of Hammonds *et al.* (1972). These differences, as compared with those of Hammonds *et al.* (1973), may be attributed to the livestock orientation of the agricultural sector in the region, which limits the range of substitution possibilities on the input side. The higher values observed in this study when compared to those estimated by Schuh and Leeds (1963) may be attributable to difference in time periods and the larger regional difference in time periods and the larger regional definition in the Schuh study.

TABLE 3. DEMAND AND SUPPLY ELASTICITIES FOR NORTHERN GREAT PLAINS AND PREVIOUS STUDIES

						Previous Studies					
	Coefficient of					Hammonds et al.[1]		Tyrchniewicz & Schuh[2]		Schuh & Leeds[3]	
		Agricultural Wage		Mining Wage		Agricultural Wage		Agricultural Wage		Agricultural Wage	
Equation	Adjustment	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
Demand											
at means	0.76	-0.76	-1.03	--	--	-1.64	-3.25	--	--	-0.130	-0.349
at 1978	0.76	-1.06	-1.43	--	--	--	--	--	--	--	--
Supply											
at means	0.95	3.05	3.21*	-0.42	-0.44*	4.02	5.15	0.248*	0.382*	(0.25)	(0.78)
at 1978	0.95	4.28	4.50*	-0.69	-0.73*	--	--	--	--	--	--

* Computed from coefficients not significant at the 10% level.

[1] Demand and supply elasticities for Oregon calculated at the means for the data period 1951-1970. Demand elasticities in parentheses are for the U.S. for the data period 1961-1969.

[2] Elasticities for the Mountain region calculated at the means for the period 1929-1957.

[3] Elasticities for the Mountain region calculated at the means for the period 1929-1957. Elasticities in parentheses are for the U.S. calculated at the means for the period 1929-1957 as reported by Schuh.

Source: Adams and Menkhaus

The supply elasticities are perhaps of greater empirical importance. The values presented in Table 3 for the agricultural wage are elastic both at the mean values and for 1978. Such an increase over time is consistent with both Schuh's and Hammonds's observations. (Note that the long run regional supply elasticity is calculated from an insignificant coefficient of adjustment.) The elasticity with respect to mining wage, which is inelastic, displays the greatest increase over the time period for any of the elasticities calculated, increasing by more than 50 percent between mean values and 1978. This increase in the response of supply of agricultural labor to changes in the mining wage adds support tothe effect of this variable on the adjustment process with respect to equilibrium levels of agricultural supply and demand. It should be noted that the elasticity of labor supply with respect to mining wages is perhaps a gross effect, given the high multiplier effect of such a basic industry. Further, the elasticity need not and probably does not imply direct substitution. However, the conclusion that agricultural labor is affected by mining does appear plausible in view of the results of this analysis.

SUMMARY AND CONCLUSIONS

The rapid development of the mining industry within the Northern Great Plains over the past decade is well documented. Motivated by rising energy prices, coal, uranium, oil and natural gas producers have accelerated the development of these natural resources and the number of workers employed within the region has increased and conversely reduced the unemployment rate to one of the lowest in the U.S.

While such development has been beneficial in terms of per capita incomes and state government revenues, certain adjustment costs are being felt. In agriculture, one potential adjustment involves the supply of labor to agriculture and the attendant wages paid in agriculture. More specifically, agriculture faces the prospect of reduced supplies of labor as workers are drawn to the relatively high wages in expanding sectors. One means of alleviating this outflow of labor from agriculture is to offer competitive wages within agriculture. Higher wages in agriculture may involve reductions in the returns to farmers and ranchers, given that individual farmers are usually not able to pass such costs on directly to the consumer.

The magnitude of any shift of labor from agriculture to mining is uncertain. No current data exist with which to accurately determine the number of workers shifting directly from agriculture to energy. It is plausible that some agricultural labor is being attracted to energy, partially motivated by the existence of a substantial wage difference between agriculture and mining. In addition, labor remaining in agriculture may have some perception of the wages within the energy sector and hence demand some adjustment in the agricultural wage. The results of the model developed in this study suggest that the supply of labor to agriculture has become more responsive to the mining wage over time. However, one need not assume any direct substitution between mining and agriculture to suggest that mining growth is altering the structure of the agricultural hired labor market, given the multiplier effect associated with a basic sector such as mining. Thus, the mining wage variable may serve to summarize (a) the derived regional labor demand in service sectors which is due to the incremental multiplier effects of changes in income in all basic sectors and (b) any direct substitution.

The hired labor market model and the data sets used in estimating this model are generally consistent with previous approaches and represent the most recent data available for this region. In addition to offering an updated examination of the functioning of a regional labor market, the results provide some quantitative support to the hypothesized effects of growth in the mining sector on the supply of labor to agriculture. The magnitude of the structural elasticities with respect to the change in the mining wage, while perhaps a gross effect, also implies an increasing sensitivity over time.

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THE GRASP SOFTWARE/DATA SYSTEM AND ITS APPLICATIONS TO SOCIAL RESEARCH

Celia A. Allard 1/

INTRODUCTION

We live in an age of data accumulation made possible by the computer. Government bureaus, private agencies, and businesses gather data and maintain files of information relevant to their particular needs. The sheer bulk of data accumulated on the scale that has occurred over the last three decades would have been dismissed as impossible 50 years ago, yet is taken for granted today. The real challenge, of course, lies not in accumulating data, but in processing it once it has been gathered.

The ability to analyze data via computer, once confined to computer specialists, became the province of a much larger data-oriented audience with the introduction of statistical packages such as SPSS, BMD, OSIRIS, and SAS. Valuable though the available canned systems may be, all were designed to operate efficiently on small or moderately sized data files. The version of SPSS at Montana State University (MSU) limits the user to 5,000 variables (Nie and others, 1975, p. 37). Although there is in theory no limit to the number of cases that an SPSS file may contain, the amount of available computer storage effectively limits the size of the file at many computer installations.

The MSU version of SPSS will accept a file of 10,000 cases and 5,000 variables. Analysis of an SPSS system file created from this data would be extremely unwieldy, since SPSS stores the value of each variable for each case in one word of computer storage. The data for a file of 10,000 cases with 5,000 variables would occupy 50,000,000 words of computer storage. The amount of computer time required to perform even simple statistical analyses on a file of this size is quite high, making SPSS analyses of large amounts of data cost-prohibitive.

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The Center for Social Data Analysis (CSDA) at MSU routinely analyzes a data file considerably larger than the one described above: a version of the Continuous Work History Sample (CWHS) (U.S. Department of Commerce, 1976). The CWHS file contains 1,317,484 cases and 1,030 variables; it is a one percent sample of the labor force employed in social security covered occupations. CWHS data are compiled by the Social Security Administration from employers' First Quarter report forms and selected other sources to provide infomation on the worker's sex; race; date of birth; annual state, county, and industry of employment; and an estimate of annual FICA income from first quarter earnings. The CSDA version of the CWHS contains these data for the years 1960 and 1965 to 1975. Work histories for individuals employed through any number of successive years may be constructed, since case identification numbers are included in the sample for each period.

The longitudinal nature of the CWHS allows a researcher to study worker profiles for different industries during different years as well as follow the movement of workers from place to place and industry to industry. Migration researchers in particular have taken advantage of the CSDA's ability to analyze the CWHS quickly and cheaply; their version of the CWHS has been the focus of a number of demographic studies undertaken during the last two years.

GRASP: A PACKAGE FOR LARGE DATA FILES

Analysis of the CWHS and other large files at MSU is made possible by GRASP (Generalized Rapid Access Software Package), a statistical package developed at the CSDA. GRASP is similar to other statistical packages from the user's standpoint, but vastly different from other packages in data base orientation. GRASP was specifically designed to provide rapid, economical access and analysis of large data files (Gilchrist and Wardwell, 1978; and Gilchrist and Allard, 1980).

The most fundamental difference between GRASP and SPSS is the arrangement of cases in the data files on which they operate. SPSS data files are arranged in the traditional case orientation, with all variables attached to each case record, and cases arranged sequentially in the file (Figure 1). This type of data file organization is by far the most common; it reflects the fact that data are usually gathered case-by-case. A typical survey, for example, involves questioning participants on a number of topics. Each participant is interviewed individually, so the results of a single interview are stored quite naturally as one case in a data file.

Data are usually analyzed by variable although accumulated and stored by case. What is of interest to the researcher are the responses of all participants to given questions rather than the particular responses of any one individual. Consequently, it makes sense to store data by variable rather than by case for purposes of data analysis. Much of the efficiency of GRASP can be attributed to the variable orientation of the data files, in which all values for each case form a single long record (Figure 1).

Case oriented data files usually are arranged sequentially. In GRASP variable-oriented data files, the records are ordered by a data directory rather than physically arranged in a particular order. File structure is entirely imposed by the data directory. Once a variable name has been entered in the directory, data for that variable can be separated physically from the data for any of the other variables recorded there (Figure 2). The data directory enables GRASP to quickly locate the data for a particular variable rather than search for it through a sequential file of variables.

The variable oriented data file structured by the data directory partially explains the CSDA's ability to analyze large data files with the limited resources available at MSU. A GRASP data analysis can be performed using only those records which contain variables actually being analyzed. For example, an analysis designed to explore the relationships between sex, race, and income from the data file of Figure 2 would require only the data directory and File 1. All the data encompassed by the directory need not be physically present in any one location at the time of analysis. Consequently, variables from the files can be stored on magnetic tapes when they are not needed for analysis and transferred to disk packs as required.

The data in GRASP files in addition to being variable oriented are word packed to optimize computer storage space. As mentioned earlier, SPSS stores each data item in a word of computer storage. GRASP, by contrast, packs data into words on the basis of maximum number of codes per variable. For example, a dichotomous variable has a mixlmum of two codes -- "yes" and "no". For any dichotomous variable, GRASP will pack the values for 32 cases into a single word of storage. This means that all values of a single dichotomous variable for all 1,317,484 cases in the CWHS file can be stored in 1/32 of the space that would be required if each data item occupied a full word of computer storage (Figure 3). Similarly, variables having higher numbers of codes can be packed 16 variables to a word, 8 variables to a word and so on.

Dichotomous variables are not created merely to save storage space however. GRASP is programmed to define samples extremely rapidly using logical combinations of dichotomous variables. In practice, dichotomous variables are used to define a basic sample; that sample can be refined as necessary using variables that are not dichotomous (and thus require

FIGURE 1. EXAMPLES OF CASE-ORIENTED AND VARIABLE-ORIENTED DATA FILES

Case Orientation

		SEX	RACE	AGE	INCOME
Record 1:	Case 1	1	1	32	10000
Record 2:	Case 2	2	1	17	5750
Record 3:	Case 3	1	1	25	16000
Record 4:	Case 4	1	2	27	24000
Record 5:	Case 5	1	1	46	30000
Record 6:	Case 6	2	3	34	17000

Variable Orientation

		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Record 1:	SEX	1	2	1	1	1	2
Record 2:	RACE	1	1	1	2	1	3
Record 3:	AGE	32	17	25	27	46	34
Record 4:	INCOME	10000	5750	16000	24000	30000	17000

FIGURE 2. RELATIONSHIP OF DATA DIRECTORY TO PHYSICAL STORAGE OF DATA

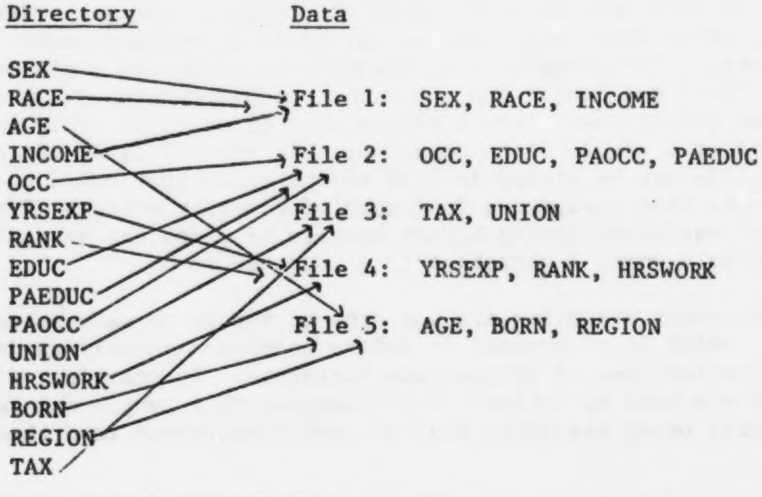
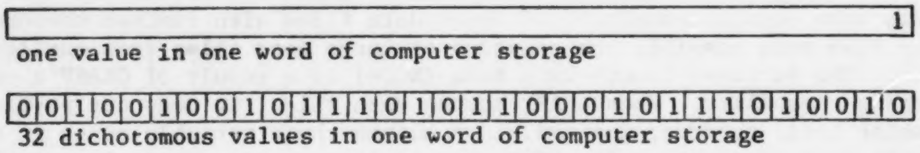

Directory
Data
SEX
RACE
AGE
INCOME
OCC
YRSEXP
RANK
EDUC
PAEDUC
PAOCC
UNION
HRSWORK
BORN
REGION
TAX
File 1: SEX, RACE, INCOME
File 2: OCC, EDUC, PAOCC, PAEDUC
File 3: TAX, UNION
File 4: YRSEXP, RANK, HRSWORK
File 5: AGE, BORN, REGION

FIGURE 3. ILLUSTRATION OF PACK VARIABLE STORAGE


1
one value in one word of computer storage
0 0 1 0 0 1 0 0 1 0 1 1 1 0 1 0 1 1 0 0 0 1 0 1 1 1 0 1 0 0 1 0
32 dichotomous values in one word of computer storage

more computer time to process). For example, the CWHS file could be used to define a sample of miners in the Western region in 1960 with the following group of dichotomous variables:

SELECT: EMP60 AND WR60 AND MINING60

For comparative purposes, this sample could be redefined for a number of different years or repeated for other regions of the country. The definition of each sample using dichotomous variables would require just a fraction of a minute of computer time.

Perhaps the most important implication of the speed of this sampling technique is the resulting potential for analyzing large data files using the same stepwise strategy that characterizes the typical analysis of small data files. Taking full advantage of GRASP's sampling capability, a researcher might plan her first computer run to consist entirely of sample definitions that would enable her to explore the size implications of the various samples. She could choose the samples best suited to her purposes for further analysis and continue the analysis as another series of steps, each designed in accordance with information obtained in previous computer runs.

A stepwise analysis of this type is common with small data files, but the sheer size of large data files stored in the traditional manner makes stepwise analysis of these files prohibitively expensive. The expense is rooted in the case-oriented structure of the file, which dictates that all records must be read by the computer to extract the values of the variable being analyzed. For a computer, reading data records is a much more time consuming process than calculating results. Since GRASP reads only the records containing the variables being analyzed, the time and expense associated with reading data records is kept to a minimum. Both approaches require approximately the same amount of computer time for calculations, but GRASP spends much less time reading data records.

THE NATIONAL COUNTY DATA BASE

Not only do the data directory and variable orientation of the files make possible analysis of large data files with limited resources, they also make possible the creation of large data files from smaller ones. The National County Data Base (NCDB) is a result of GRASP's unique merging capability. When GRASP merges data files, it does not physically combine their records; instead, it combines their variable names in a single data directory. The NCDB is actually a huge number of variable-oriented records sharing a common data directory. All files merged in the NCDB contain county level data, and it is a fairly simple matter for GRASP to add new county level files to the NCDB. With each file merger, the NCDB becomes a more versatile analytic tool, since any variable in the file can be analyzed in terms of any other.

The National County Data Base contains demographic, economic, environmental, and social information for all counties in the United States. Most of the data are longitudinal, permitting comparative studies over time. The NCDB is currently comprised of the following seven files, which are described briefly below:

(1) BEA Employment and Income Series
(2) County Portion of the 1947-1977 Consolidated County and City Data Book
(3) Area Measurement File
(4) Area Resource File
(5) Fourth Count County Summary Tape (Human Resources Profile)
(6) Population and Net Migration Estimates
(7) Bowles 1950-1960, 1960-1970 Net Migration Rates

BEA Employment and Income Series [2]

The BEA employment and income data provide information concerning the number of workers within industries and the aggregate income of wage earners within industries. These county-level data are available annually for the period from 1969 through 1977. Used independently or in conjunction with the CWHS, the BEA series provide the information necessary for analysis of changes in county-level work force and industrial structures. They are also used in conjunction with sociodemographic characteristics from the Fourth Count County Summary Tape to identify what types of counties are experiencing what types of change in employment structure and earnings.

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[2] Restricted data; permission to analyze must be obtained from Dick Stuby, EDD,USDA.

County and City Data Book

The 1914-1977 consolidated county information consists of a longitudinal series of basic social, economic, and demographic data including items drawn from a variety of governmental and private agencies. Detailed data are provided for population, employment, vital statistics, school enrollment, health, income, public assistance, social security, banking, housing, government employment and finance, elections, crime, manufacturing, retail and wholesale trade, selected services, mineral industries, agriculture, and weather.

The county portion of the County and City Data Book is incorporated into the NCDB; the CSDA may eventually nest the cities within their counties and aggregate across units to obtain additional county level characteristics.

Area Measurement File

The Area Measurement File is provided by the Bureau of the Census and is used to append the coordinates of county population centroids to the county characteristics data system. With these coordinates, distances between counties can be calculated to provide a measurement of distance in migration studies. The land and water area of counties are also obtained from these data and are used to provide a rough indication of the amenities available for development of recreation within the county.

Area Resource File

The Area Resource File is a county-based compendium of health-related data developed in 1971 by the Health Resources Administration. It contains detailed information on health manpower, facilities, and training; population characteristics and economic data; hospital utilization and expenditure data; and environmental data pertaining to health, such as large animal population, elevation, mean temperature and humidity, precipitation, and water hardness index. Various data elements are available for different years; the ARF is updated and expanded periodically. The version of the ARF available in the NCDB is that of August, 1978.

Fourth Count County Summary Tape

The Fourth Count County Summary Tape, or Human Resources Profile (Hines, et al., 1975) is a selection of demographic, social, and economic characteristics of counties drawn from the 1970 and 1960 censuses of population. The 1970 data are drawn from 15 percent and 20 percent samples, and the 1960 data from the 25 percent sample. It is the major data set available for contrasting characteristics of metropolitan and nonmetropolitan counties. When variables from this source are merged into the CWHS file, the CWHS can be used to construct gross flows of worker movement between counties grouped on the basis of detailed characteristics.

The major characteristics included in these data deal with population growth and distribution; population composition with respect to age, sex, and family structure; labor force participation and occupational structure; education; income; and incidence of poverty.

Population and Net Migration Estimates

The Bureau of the Census makes available a tape including the 1973-1977 population and components of change estimates for each county. These estimates are prepared under the Federal-State Cooperative Program for Local Population Estimates. The data consist of provisional and final point estimates of population for each year, births and deaths from April 1, 1970 to the end of the respective calendar year (i.e., 1970 to 1974, 1970 to 1975, etc.), and residual net migration (i.e., the difference between net change and natural increase).

These data can be used in conjunction with county characteristics data to identify variations in net migration experience by type of county. They can be used in conjunction with CWHS data to compare patterns of net employment movement with net residential migration.

Bowles Net Migration Rates

Estimates of net migration by age, sex, and color have been prepared for each county (and larger aggregations -- states, divisions, and regions). Bowles and Tarver (1965) prepared these data for the 1950-1960 decade; Bowles, Beale, and Lee (1975) have extended the earlier work to the 1960-1970 decade. These data provide mobility trends affecting rural and nonmetropolitan counties and regions in the decades prior to the onset of the nonmetropolitan migration turnaround. Used in conjunction with the later data (i.e., 1973-1977), they aid in defining counties experiencing varying degrees and forms of change. These counties are then analyzed in terms of their structural, functional, and geographical characteristics to provide the bases for inferring causes for and consequences of demographic change.

Possible Additions

Other data sets under consideration for addition to the National County Data Base include the County Business Patterns to provide FICA-covered employment information by size of firm to the 4-digit SIC (Standard Industrial Classification) level; the Census of Governments data on county-level revenues and expenditures to examine fiscal and service impacts of growth; and ultimately, the 1980 census county characteristics data as they become available.

THE NCDB COUNTY STANDARD

The greatest difficulty the CSDA encountered in collating these data sets was not a function of software or hardware; it was the purely mechanical problem of coordinating the county codes in the various data sets. A county code standard which would overcome the discrepancies among the individual source data sets had to be created in order to merge these data files into a single National County Data Base. Such resolution was necessary to provide the basis for a single file in which county data were comparable regardless of the data set of origin. The county standard allows an analysis of any variable in the National County Data Base in terms of any other variables. The standard is the 1970 FIPS county code standard with extra codes added to resolve specific problems (Figure 4).

The most troublesome county coding discrepancy encountered concerned the treatment of counties in Virginia and Alaska. Some data sets contained aggregated data for Alaska and Virginia, while others contained data for the individual units (the new Bureau of the Census units for Alaska, the independent cities and county remnants of Virginia).

FIGURE 4. NCDB-FIPS COUNTY STANDARD DISCREPANCIES

Total counties and county equivalents in FIPS standard:		3142
Units added to NCDB standard		+ 96
United States code	1	
Statewide codes	50	
Alaska aggregate codes	3	
Virginia Aggregate codes	32	
Wisconsin aggregate code	1	
Outdated/new Virginia FIPS codes	9	
Units removed from NCDB standard:		- 2
Kalawao, HI	1	
Yellowstone Park, part, MT	1	
Total counties and county equivalents in NCDB standard:		3236

Data that had already been aggregated could not be disaggregated. The alternative seemed to be to aggregate the data for the individual units and retain only aggregated data in the NCDB. There was not, however, sufficient information to aggregate some of the variables present -- median values, ranking values, and some percentage change values, for example.

This problem was resolved by retaining the county codes for the individual units and adding a special series of codes for aggregated units of Alaska and Virginia. This solution has the advantage of preserving both the individual unit data and the aggregated data; it has the disadvantage of requiring that some values be omitted during every data analysis to avoid duplication of county units.

The NCDB contains data for the individual units from all files except those files offering only aggregated data. It contains aggregated data from the aggregated files and also aggregated variables from other data sets where the aggregated values were simple calculations such as sums and means. For the sake of completeness, the CSDA plans to aggregate as much of the individual Alaska and Virginia data as possible. Some of the calculations required are rather elaborate, however, the aggregation will proceed slowly and steadily over time.

APPLICATIONS OF THE SOFTWARE/DATA SYSTEM TO SOCIAL RESEARCH

The GRASP software/data system offers many advantages to those engaged in social research. The National County Data Base is unique in the nation in its array of social and economic indicators, and the number of indicators available will increase each time a new data set is added. The addition of the 1980 census county characteristics data will broaden significantly the scope of the NCDB and make it a more valuable tool for social research. The versatility of the NCDB is further heightened by its relationship via GRASP to the CWHS file. Worker-oriented data from the CWHS can be computed for county units and attached as new variables to the NCDB. Conversely, county level NCDB data can be attached as contextual properties to cases in the CWHS file. A researcher possessing a county level data set can submit that file for inclusion in the NCDB to considerably extend her base of variables available for analysis.

The Center for Social Data Analysis at Montana State University provides access via GRASP to the Continuous Work History Sample and the National County Data Base for researchers in government agencies, private corporations, and universities. The GRASP software itself is not available for transfer to other computers at this time. GRASP was developed on the Sigma 7 computer at MSU, and some of its programming code is machine specific. Montana State University is currently acquiring a new computer, however, and GRASP must be converted to run on the new system. The new version of GRASP will be written in FORTRAN 77, a language which operates on many machines. Meanwhile, the CSDA will provide both data and data analyses for interested researchers.

The CSDA will provide magnetic tapes containing those cases and variables specified for those researchers wishing to acquire data for analysis on their own computer systems. Since the seven data sets discussed earlier effectively have been merged as the National County Data Base and have a common county standard, variables from any of the seven original data sets can be treated as though they came from the same data set (as in fact they now do). The sample of cases specified may be a few selected counties, a state, a region, or the nation as a whole.

The data from these tapes can be transferred to the computer at the researcher's institution, and can be analyzed using methods available. This service enables researchers to acquire data of a breadth that they might have neither the time nor the resources to acquire in any other way, since duplicating our collation is rather complicated and collecting the data available in libraries is extremely time consuming. The disadvantage of acquiring data tapes for computer transfer is that the efficiency of GRASP for data analysis is lost when this option is taken, however.

The researcher can specify the analysis and have it executed at the Center for Social Data Analysis to take full advantage of the data retrieval and analytic capabilities of GRASP. The researcher is allowed considerable flexibility in her analytic specifications. The traditional approach to the analysis of a large data file has been to acquire the maximum amount of information possible during a single computer pass through the data file. The rationale for this originates in the case-oriented structure of most data files. When each record in a file must be read by the computer to extract information, as much information as possible must be gleaned from a single computer run. There are two disadvantages to this approach. First, if the researcher specifies an elaborate analysis and has incorrectly estimated the samples or misspecified the variables on which that analysis is based, much of the data she received from the computer may be virtually worthless for her purposes. Second, much of the data generated by a one-pass analysis may prove unnecessary or irrelevant for the project. Unfortunately, the cost of examining large data files by computer has always been expensive. Sample counts and test runs simply have not been possible except in instances where funding is not an issue.

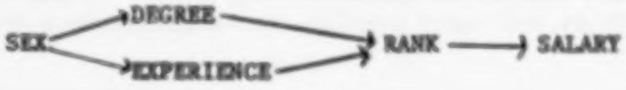
This picture changes dramatically with GRASP. GRASP's variable oriented data files and rapid sampling techniques make a stepwise analysis of large data files both logistically and financially feasible. The CSDA encourages researchers to explore the size implications of all samples under consideration before the full data analysis is run. Many of the analyses performed consist of several computer runs, each building on the results obtained from previous runs. A stepwise approach to data analysis is encouraged for researchers who are unfamiliar with the data file being analyzed, and for those who wish to probe the data file to see what information is available.

This does not mean that the CSDA never performs a traditional one-pass data analysis. Such analyses are frequently performed for researchers who know exactly what they want from a data file and are familiar enough with the data that the chances of satisfaction with the resultant analyses are high. All is not lost even in those cases where the one-pass analyses are disappointing. GRASP data analyses are cost effective, so all or part of a wayward analysis can be repeated without impoverishing the researcher.

Finally, the researcher can benefit from the GRASP software/data system by taking advantage of the analytic routines available. GRASP is still young compared to more widely available statistical packages; while all the common statistical routines are available in GRASP, some of those less frequently used are not. However, GRASP has a few extremely useful procedures that are unavailable elsewhere, such as the nonrecursive path analysis routine and the comparative case analysis procedure.

A researcher wishing to undertake a nonrecursive path analysis must first develop a model consisting of a number of related variables and the postulated causal relationships between them (Figure 5). Input for a path analysis of the above model would be a list of the variables involved and a list of the paths between them (e.g., SEX to DEGREE). Given this input, GRASP identifies the path coefficients for all postulated paths in the model. GRASP also decomposes the zero order correlation coefficients between the variables into causal paths (both direct and indirect) and noncausal paths and then identifies the relative proportion and unique contributions of each of these components to the original zero-order correlation. GRASP illustrates these paths graphically and gives the products of the path coefficients involved. Paths can be added and deleted at the discretion of the researcher during the analysis.

FIGURE 5. CAUSAL MODEL FOR PATH ANALYSIS



GRASP's comparative case analysis routine allows analysis of relationships between individual cases. Any statistical package can determine the number of persons in a sample within a given salary range, but GRASP can also determine how many are within X dollars of another and, for those who differ by X dollars, the average difference. The matching capability of GRASP is not limited to case by case comparisons of one characteristic; ranges may be specified for several characteristics and the comparison made using all of them. The following GRASP commands would define a comparison of all cases in the MSU Sociology Department; the output lists the cases matched and the difference in values for each of the variables involved in the comparison.

FIGURE 6. AN EXAMPLE OF THE GRASP MATCHING COMMAND

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SAMPLE:  (COLLEGE=6) AND (DEPT=6158)
MATCH:   SEX (DIFF>0) AND DEGREE (DIFF=0) AND RANK (DIFF=0)
         AND SALARY (DIFF<>50000)
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The above analysis matches all pairs of cases differing in sex and salary while having the same degree and rank.

GRASP will also limit the matching to particular specified cases. For example, a researcher might choose a particular county of reference which experienced a decline in population over a given period. GRASP could determine which other counties in the country have experienced a similar population decline. The comparison could be extended to changes in industrial composition or income levels.

Another unique feature of GRASP is its series of linkages designed to accomodate user-defined procedures. These linkages offer the researcher the opportunity to truly custom design her analysis. If she is conversant in standard FORTRAN, she can write her own subroutine to be linked to GRASP. Alternatively, she can specify the type of analysis desired and leave the actual programming to CSDA staff The most elaborate routine of this type developed to date takes as input crosstabulation data from three time periods and uses these data to calculate a series of migration-related ratios.

During the past three years, a number of researchers have taken advantage of the GRASP software/data system to further their investigations. Much of the early research using GRASP focused on the nonmetropolitan turnaround phenomenon through analyses of the CWHS. The National County Data Base has existed for less than a year, so research utilizing that file has been less extensive. A partial list of research topics appears below:

(1) Industrial deconcentration trends within states of interest compared to national trends;

(2) Patterns over time in nonmetropolitan retention of recent metropolitan-to-nonmetropolitan migrants;

(3) Variations by region of the nation in sequence and extent of metropolitan employment deconcentration;

(4) Separation of intraregional and interregional metropolitan-to-nonmetropolitan migration flows;

(5) Separation of intrasystemic and intersystemic movement in deconcentration processes;

(6) In-depth descriptive profiles of changing socioeconomic trends in individual metropolitan and nonmetropolitan counties and groups of counties;

(7) Patterns of change in workforce structure and industrial distribution at the state level or by other groupings of county units;

(8) Income inequality by region and race, focusing on counties in the South; and

(9) Impacts of mining developments on population and economic structure of rural states in the Northern Great Plains.

Some of these analyses utilize the CWHS, some the NCDB, and some use both of these files. One of the more comprehensive analyses executed to date required the creation of a data file incorporating variables from both the NCDB and the CWHS. The records for this file were counties comprising selected SMSA's, and the variables were drawn from the NCDB and computed for each county of interest from the CWHS. Variables also were computed from combinations of the variables already in the file. This custom-designed file contained several hundred variables from a variety of sources when it was complete; it represents a truly creative use of the GRASP software/data system.

An impressive amount of research has already been completed using GRASP, but the investigations undertaken thus far only begin to tap the potential uses of the system. With the existing data bases, longitudinal and cross-sectional analyses of social, economic, and demographic phenomena can be obtained with a breadth that was previously impossible at such speed and low cost. GRASP's unique merging capabilities have dissolved the boundaries between discrete county-level data sets with the creation of the National County Data Base, a file which will become increasingly versatile as new data sets are incorporated. The possibilities for exploratory analyses represented by the GRASP software/data system are limited only by the imagination and creativity of the researchers who take advantage of the opportunities offered by the system.

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MODELING DYNAMICS AND DISEQUILIBRIUM IN LOCAL IMPACT ANALYSIS: A LITERATURE ASSESSMENT

George S. Temple [1]

INTRODUCTION

Existing models of rapid growth are equilibrium models. But rapid growth, illustrated by boomtowns associated with western energy development, probably is as clear an example of a disequilibrium process or dynamic adjustment process as one is likely to find. Current work on dynamics and disequilibrium would seem to have a ready application. This paper examines that work in the context of rapid regional growth, and discusses its applicability.

Descriptions of the rapid growth process are familiar. Western energy development mostly occurs in sparsely settled rural areas. The indigenous population supplies enough labor to satisfy the requirements of the local, uncomplicated economies. Energy projects are of large scale compared to these economies. Therefore they are often disruptive of local labor markets and public fiscal institutions. Impacts are quite visible, and take time to work themselves out.

Changes in population summarize the timing and magnitude of impacts. Many factors influence local population changes in response to employment changes. Foremost among these are the local multiplier effects, labor force participation rates, the demographic composition of the population, and the extent of commuting.

Local county employment multipliers are small due to the simple economies which service agriculture and provide basic consumer services. There is little manufacturing. Most agricultural inputs and consumer goods are imported and agricultural products are exported in raw form from the region. The same tendencies will hold true for coal mining activities in the near future. Also excess capacity in the private service sectors is another reason that incremental multipliers tend to be small and nonlinear.

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Participation rates and the demographic composition of the labor force change as employment increases rapidly in a rural area. During construction periods, for instance, much of the new labor is composed of single workers with extremely high participation rates. The participation rate of residents increases as well during periods of high labor demands. In each case, the effect is that population increases more slowly than employment, especially in more densely settled areas.

Finally, workers may commute long distances to jobs if local housing is unavailable or expensive, especially when construction crews are large relative to the resident work force. Population impacts in these cases are distributed over a wide geographic area along major commuting routes.

However, these are initial effects. Once the construction phase is finished, jobs associated with the energy project appear more stable and of long term. Workers settle in the region with their families. Rather than commute long distances, workers buy local housing, often new construction. The service sector expands. Average participation rates may return to "normal" levels. All of these imply migration into the region as the local economy adjusts to its new equilibrium position.

There is no reason to suppose that this adjustment takes place instantaneously. Since it requires migration as part of the equilibrating response, the adjustment is likely to be rather slow. Indeed, the stereotype of a boomtown is a position seemingly far from equilibrium. Part of the problem of analyzing impacts, then, is the issue of the duration of the disequilibrium situation. This is disequilibrium dynamics.

LITERATURE ON DISEQUILIBRIUM MODELING

There is a recent and growing literature on disequilibrium modeling. In this section, that material is considered from the viewpoint of rapid growth analysis. None of the papers are oriented toward regional analysis. The question is whether any of the approaches can be adapted to this kind of analysis. The critical concern is whether the disequilibrium models incorporate adequate dynamic features.

The available literature can be divided into three groups: the disequilibrium macroeconomic models, which take a general equilibrium (general disequilibrium) approach; microeconomic models, which are usually concerned with single markets and deal in partial rather than general analysis; and a somewhat miscellaneous category of work investigating the theoretical foundations of disequilibrium and dynamics.

The groups are not equally relevant to regional modeling. Most important are the microeconomic, econometrically oriented papers. The others turn out to be peripheral, but are addressed first.

Theoretical macroeconomic models are presented in papers by Barro and Grossman (1971), Buiter (1975), and Portes (1977). These analyses are not useful for rapid growth applications because the models are not dynamic, but rather comparative static disequilibrium models. The essence of the rapid growth problem is that the disequilibrium associated with it is a consequence of the significant dynamic changes coming about -- at bottom it is an adjustment problem. Comparative statics are insufficient to deal with this.

What the models do -- taking Barro and Grossman as an example -- is to consider two sectors, a labor market and a goods market. The existence of excess demand or supply in one sector is assumed, and the implications for excess demand or supply in the other sector are examined. Little attention is paid to any economic process which could eliminate the disequilibrium. Rather the approach is used to shed light on traditional macro concerns -- static questions. A paper by Gourieroux, Laffont and Monfort (1980) is the only macroeconomic paper that is empirically oriented. Its contribution is to consider methods of estimation of disequilibrium models in a simultaneous equations context. The only other paper to consider this issue is one by Quandt (1976). Further discussion is deferred to the empirical section.

Another category consists of papers which deal with the meaning of disequilibrium, and with the economic theory deriving from it. A paper by Kornai and Weibull (1977) is an example.

The paper discusses a queuing model applied to a shortage economy. The model is meant to apply to economies such as those in eastern Europe where queuing for consumer goods is a normal aspect of the economy. The price of a good includes both a money price and waiting time in a queue. Alternatives to buying the good are buying something else (with no waiting time), postponing a decision, or forced saving. There is no uncertainty in the model; the consumer knows just how long he must wait if he joins the queue. The waiting time is not constant; the length of the queue can vary, but at any time it is certain how much waiting time is associated with a given queue. The model is used to predict queue length. This depends on such factors as the strength of preferences of consumers for the good in excess demand compared to other goods, willingness to queue, and how rapidly a unit of the good is used up.

The paper is useful because of the way it integrates queuing into what is really equilibrium analysis. One usually thinks of queuing as a manifestation of excess demand and hence of disequilibrium. But in this model there are no forces set in motion to eliminate the queue. Everyone who wants the good enough to join the queue eventually is able to buy it. All demand is eventually satisfied. Queues do not lengthen indefinitely. The price of the good is the sum of the dollar price and the waiting time. This produces an equilibrium queue length. Markets don't "clear" at each point in time, but this is because paying the price for the good requires time.

This suggests that there can be "equilibrium excess demand" and "disequilibrium excess demand". The latter obtains when forces are set in motion which change the behavior of demanders or suppliers or both; that is, when something happens to eliminate queues.

For rapid growth analysis queuing probably is to be regarded as a disequilibrium phenomenon. The Kornai-Weibull model might be applicable during the disequilibrium phase, but would be incomplete in that it would not explain the changes moving the rapid growth economy towards equilibrium.

The final group of papers considered are microeconomic in approach. The papers in this section form a homogeneous group in terms of subject matter. All are primarily about the econometrics of disequilibrium models. All consider variations of the same basic model, and ask similar questions. There are signs that this work is becoming the standard approach to disequilibrium analysis. Structural aspects common to all the papers are considered first.

Probably the most accessible papers of the group are by Fair and Jaffee (1972) and by Rosen and Quandt (1978). Other representative papers are by Quandt (1976), by Maddala (1979), and by Gourieroux, Laffont and Monfort (1980). The models in these papers are not meant to be definitive dynamic disequilibrium models. The dynamic structure is primitive or sometimes nonexistent. In some cases the models make no economic sense. They are intended only to illustrate the variations in estimation methods as one moves to alternative specifications. However, the disequilibrium structure, which is common to all models, is well specified. It is the disequilibrium structure which leads to the interesting econometrics.

The key criticism is that the well-developed disequilibrium structure, combined with an incomplete dynamic structure, implies peculiar dynamic behavior for some variables. This is most easily seen using one of the more fully developed models such as the Rosen-Quandt model or Fair and Jaffee's Quantitative Method. Such a model consists of four equations:

$$(1)\quad Q_t^d = f(p_t, X_t^d)$$

$$(2)\quad Q_t^s = g(p_t, X_t^s)$$

$$(3)\quad Q_t = \min\,(Q_t^d, Q_t^s)$$

$$(4)\quad \dot{p}_t = k(Q_t^d - Q_t^s),\ 0 < k < 1$$

Equations (1) to (3) comprise the static structure of the model. Equation (4) supplies the dynamics. The first two equations are ordinary demand and supply curves. Equation (3) specifies the disequilibrium structure. The plausible reason behind it is that if price is at any disequilibrium level, restriction on quantity actually traded should come from the function which implies the smaller quantity. So if price is below the equilibrium price, quantity traded will equal quantity supplied and some demand will be unsatisfied. The converse holds if price is initially too high. That is, given voluntary markets, supply and demand curves represent the maximum quantities that will be traded at any price.

An implication of the model is that $\dot{Q}_t$ is never negative. Quantity can never decline. This is easily seen by writing:

$$\dot{Q}_t = \dot{p}_t \frac{dQ_t}{dp_t} = k(Q_t^d - Q_t^s)\frac{dQ_t}{dp_t}$$

Now $\frac{dQ_t}{dp_t}$ is just the slope of the demand curve or the supple curve (whichever is operative according to equation (3)). Given normally sloped curves, the result is that $\dot{Q}_t \geq 0$. This is fine as long as the source of the disequilibrium is expansion. The reader can easily verify that if either the demand curve or the supply curve shifts outward, Q grows and p moves to new equilibrium values at rates which depend on k and on the slopes of the curves.

But this plausible behavior breaks down if either curve shifts inward. It is equally easy for the reader to verify that in this case, p moves at a finite rate to its new equilibrium value. The behavior of Q, on the other hand, exhibits two kinds of movement. Initially it declines instantaneously. This is required by the min condition. Then it grows at a finite rate until it reaches its new equilibrium level. Since the initial decline is instantaneous, it is "outside" the model in a sense, and does not contradict the conclusions about $\dot{Q}_t$.

The salient feature about this is how peculiar it is. When a curve shifts inward, it is normally associated with a decline in quantity. To model this by a large, instantaneous drop followed by growth at a finite rate is not plausible. Moreover, it is the disequilibrium specification that is really responsible for the situation.

One could certainly object that this criticism is artificial, and occurs only because the dynamic structure is not fully specified. The assumption of instantaneous shifts in demand or supply curve is equivalent to assuming that $\dot{X}_t$ is infinitely large. If $\dot{X}_t$ is really finite, then $\dot{Q}_t$ would decline at a finite rate.

But this raises as many questions as it answers. Most important is whether such a specification is consistent with disequilibrium. If demand and supply curves shift at finite rates, price and quantity may change just as fast, implying continual equilibrium. One might rescue disequilibrium by supposing that prices adjust more slowly, but this is merely an assertion. Indeed, the common assumption is that prices change faster than other things; otherwise there is no point in describing slides along, as opposed to shifts in, curves.

Even if one assumes disequilibrium, how to model it is unclear. Equation (3) might not be satisfied. If P_t and Q_t adjust more slowly than X_t, Q_t may be outside the demand and supply curves. This contradicts the understanding of those curves as representing maximum quantities people wish to exchange. Some other explanation of disequilibrium would be needed, and there is no obvious candidate.

The lesson to be drawn is that a proper dynamic specification is not only necessary but is a prerequisite to modeling disequilibrium. Only when the dynamics are in place can any disequilibrium structure be imposed on the model.

This suggests that the four equations above are a prototype rather than a finished product. This is admittedly true in terms of the dynamics. But the arguments above suggest it may also be true in terms of the disequilibrium structure. The next step would be to discuss some of the ways in which the model might evolve. But before doing this it is advisable to examine some of the econometric issues posed by the prototypical model, while recognizing that these may or may not be relevant to later versions.

The basic econometric problem seems to be partitioning the observations between the demand curve and the supply curve, assuming that observations lie on one or the other (but not both). How this is best done statistically depends on the information available to use in allocating the observations. The model with the least information consists of equations (1) to (3). Price is exogenous. One way of proceeding is to derive the probability that any observation lies in a particular curve, conditional on the values of the exogenous variables including price. From this a likelihood function can be found and maximized. This is the method used in all the papers mentioned above. Another way is to use the segmented regression technique developed by Cook, Lubov and Stinson at the University of Minnesota. This technique allows one to test for the optimal division of observations into one, two, or three regression lines. In this case, we know there are two lines and the technique would optimally assign the observations to each line.

Models with additional information are those in which price plays some extra role. The role can vary. One possibility is that the direction of the price change signals whether excess demand is positive or negative, and hence which curve the observation applies to. Another possibility is that price is an endogenous variable through some relationship such as equation (4). Each type of model leads to a different likelihood function, and it is the derivation of these that occupies most of the material in the papers named above.

There are a number of subsidiary points which round out the econometric literature. Quandt (1976) points out that if there is insufficient information in the model the likelihood function is unbounded. One example is if the model consists of equations (1) to (3). Unboundedness implies that iterative maximization processes do not converge. In general, however, this problem disappears if one is able to supply more information, such as equation (4). Another problem pointed out by Quandt is that it may not be easy to test the hypothesis of an equilibrium structure against a disequilibrium model. This is especially true if the parameter set under the equilibrium hypothesis is not a subset of the parameter set for the disequilibrium model. Technically, the hypotheses are not nested. Maddala (1979) points out that the source of this problem is model structure. One must ask what in the model produces the (possible) disequilibrium, and then try to design a test. This can be done in some cases.

Finally, it is interesting to note the changes that occur in estimation methods as very small changes occur in dynamic specification. The alternatives considered in these papers amount only to current or lagged values of prices in the supply and demand curves. To begin with, Maddala points out that the correct specification depends on the interpretation of the model. The direction of causality determines the specification: if prices change in response to excess demand, the lagged formulation is right. If excess demand exists because prices can't adjust immediately, the current specification is preferred. However, these alternatives don't affect the likelihood functions much. But this conclusion changes when more than one market is contained in the model. Both Quandt and Gourieroux, Laffont and Monfort (1980) consider multimarket models. Quandt's is specified using current prices. The other paper uses lagged endogenous prices. This model turns out to have a likelihood function which is more easily maximized.

LITERATURE ON DYNAMICS

Truly dynamic models of the labor market are even less well developed than disequilibrium models. At best there are some indications of the right direction to take. This section will summarize a model adapted from Sargent (1979). By way of introduction, models presented by Nadiri and Rosen (1974) and Lucas and Rapping (1969) briefly are considered.

The Lucas and Rapping model is a macroeconomic and the Nadiri and Rosen model a microeconomic model of labor markets. They are similar in that each model has a short run and a long run aspect. What motivates the Lucas-Rapping model is a desire that labor supply functions be homogeneous of degree zero in all variables in the long run (as classical optimizing behavior requires) but allow for responses to money wage changes in the short run (to model the business cycle). This is accomplished by deriving an aggregate supply function which is a difference equation. In the short run, aggregate supply responds to price changes. In the long run, if prices are stable for a long period the supply function becomes perfectly inelastic. What is suggestive about this model is that it is dynamic in that a difference equation is used. However, the temporal aspect is rudimentary because the equation is derived from a two-period model. This point will be developed more fully later.

The Nadiri-Rosen paper can be thought of as a bridge between the formal dynamic model to follow and the disequilibrium models of the last section. Like the Lucas-Rapping paper, there is an explicit comparison of short run versus long run properties. Lucas-Rapping generate the long run from the short run by assuming regularity in certain independent variables, such as the price level. They impose regularities such as constant prices as part of the definition of the long run. Once this is done, the properties of the supply function are deduced. Nadiri and Rosen, in contrast, define the long run as the period when labor demand satisfies a particular functional form. The short run is a period of adjustment to this equilibrium. Thus the Nadiri-Rosen model can be out of equilibrium in the short run. This is not allowed in the Lucas-Rapping model, which is explicitly in equilibrium continuously.

The Nadiri-Rosen model assumes a Cobb-Douglas production function. Factors — independent variables — include both stocks of inputs and utilization rates. The first problem considered is to derive long run factor demand functions. This is done in standard fashion by minimizing input costs subject to the production function. Several interesting results emerge. First, long run scale effects occur in factor stocks but not in utilization rates. This coincides with a priori expectations, and results from the assumption of unitary elasticity of substitution between any factor stock and its corresponding rate of utilization. Second is the effect of factor price changes. Factor prices are defined to include a number of components. For example, labor costs include items such as wage rates, which imply that costs depend on utilization rates; labor costs also include some user costs such as personnel departments which correlate with labor stocks. The effect of a change in factor prices depends on what part of the overall factor price changes. As an example, an increase in wage rates increases demand for labor stocks but decreases utilization rates, with the latter effect dominating total labor hours. The reason that stocks increase is that there is a substitution effect between stocks and utilization rates.

Short run disequilibrium is allowed for by a type of partial adjustment mechanism. Specifically, the actual change in the quantity of an input in a period is a linear function of the difference between long run equilibrium levels and last period's levels of all inputs (not solely the input of interest). This provides feedback and interaction among inputs; for example, a large gap between desired and actual stocks may affect utilization rates. These functional forms can be translated into equations identical in form to standard distributed lab models, implying that such models can be interpreted in terms of feedbacks and interactions among independent variables. Finally, conditions for dynamic stability and speed of response are derived. One interesting result is that all inputs have the same adjustment coefficients. This is a consequence of the reduced form of a set of difference equations. So the lag structure will be equivalent across inputs. The economic meaning of this is that disequilibrium with respect to one input necessarily implies disequilibrium elsewhere in the set of factors, as long as the firm operates on its production function frontier.

The Lucas-Rapping model is attractive in that it derives a (dynamic) difference equation from optimization by economic agents. The Nadiri-Rosen model is useful in showing that continuous equilibrium is not necessary for a well-founded dynamic model of economic optimization.

However, both models suffer from the use of short run versus long run thinking. This distinction becomes unnecessary when a complete dynamic structure is specified.

The following model from Sargent (1979) is an example of such a structure. It is a simple model of labor demand only. To be complete it needs to be combined with a labor supply model and a statement of equilibrium or disequilibrium market behavior. But it illustrates the methodology dynamic models require.

Assume that a firm uses a single factor, labor. It faces a linear production function and also finds it costly to adjust its labor force from one period to the next. It is a perfect competitor in all markets. The firm desires to maximize V_t,

$$V_t = \sum_{j=0}^{\infty} b^j \left[(f + a_{t+j} - w_{t+j})n_{t+j} - \frac{d}{2}(n_{t+j} - n_{t+j-1})^2 \right]$$

where b is a discount rate, n is employment, f is value of output, $\{a_{t+j}\}$ is a sequence of shocks to productivity, and $\{w_{t+j}\}$ is a sequence of wage rates.

In this formulation, the firm has an infinite time horizon, but this is not crucial. In words, the firm maximizes the discounted sum of production, net of factor costs and adjustment costs. Necessary conditions include the Euler equations. In this problem, each Euler equation is a second-order difference equation in employment, one for each j, which has the form:

$$bdn_{t+j+1} - d(1+b)n_{t+j} + dn_{t+j-1} = W_{t+j} - f - a_{t+j}$$

(For details of the mathematics producing this and the following results, see Sargent (1979)). Solution of this difference equation yields the following demand curve for employment.

$$n_{t+j+1} = n_{t+j} - \frac{1}{d} \sum_{i=1}^{\infty} b^i (w_{t+j+i} - f - a_{t+j+i})$$

This states that this period's employment will differ from last period's by an amount that depends negatively on future wages, positively on future productivity, and negatively on costs of adjusting the work force.

A model like this can be extended in several directions. More complicated objective functions are easy to imagine, although one can very quickly introduce terms that make solution of the difference equation difficult. Introducing uncertainty can be done readily, either by the addition of random errors directly or by defining sequences such as $\{a_{t+j}\}$ to be stochastic processes. As long as V_t contains only linear or quadratic terms it is easy to handle uncertainty.

As indicated above, the real bottleneck with this approach is that making the model more realistic also makes it harder to solve. The difficulty of solution increases rapidly, so that progress is slow. Nevertheless, even simple models such as the above may produce valuable insights. When combined with the other components needed to complete a full labor market model, the results may be useful for analyzing local impacts.

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ASSESSING COMMUNITY IMPACTS THROUGH THE BLM PERMITTING PROCESS

David C. Williams [1]

INTRODUCTION

The primary objective of the Administration's energy policy for the early 1980's is to reduce America's dependence on imported oil. The cheapest and most immediate way to do that is to conserve -- first by cutting back consumption, but more importantly by making more effective use of what we do consume. In the long run, we have to concentrate on using renewable energy resources -- such as solar.

For the middle run, however, our energy policy calls for new -- or more intensive development of existing -- oil and gas production, and for significantly increased use of our massive coal resources. Most of that development will come in the West. And within the West, much of that development will occur on the public lands. Public lands are those Federal lands managed by the Bureau of Land Management. They total over 417 million acres -- over 20 percent of the land surface of the United States. Since they are concentrated in the eleven Western States and Alaska, they are a higher portion of Western lands -- roughly three-fourths of Nevada, and one-half of Alaska, for example.

More than one-half of the coal reserves of the country are on (or under) public lands. BLM now is developing a comprehensive coal management program which will lead to a regular, long-range leasing of public lands for coal mining, starting in 1981. Much of that coal will be used for generation of electric power, or for conversion into synthetic fuels. The remainder will be shipped out of the area, mostly by rail, but increasingly by coal slurry pipelines. In a sense, the coal "converted" in the region will be shipped out too, by electric power transmission lines, or by pipelines for synthetic gas. Given the amount, and the scattered pattern of, the public lands, it is going to be quite unusual to develop major energy projects in the West without involving the Bureau of Land Management (BLM).

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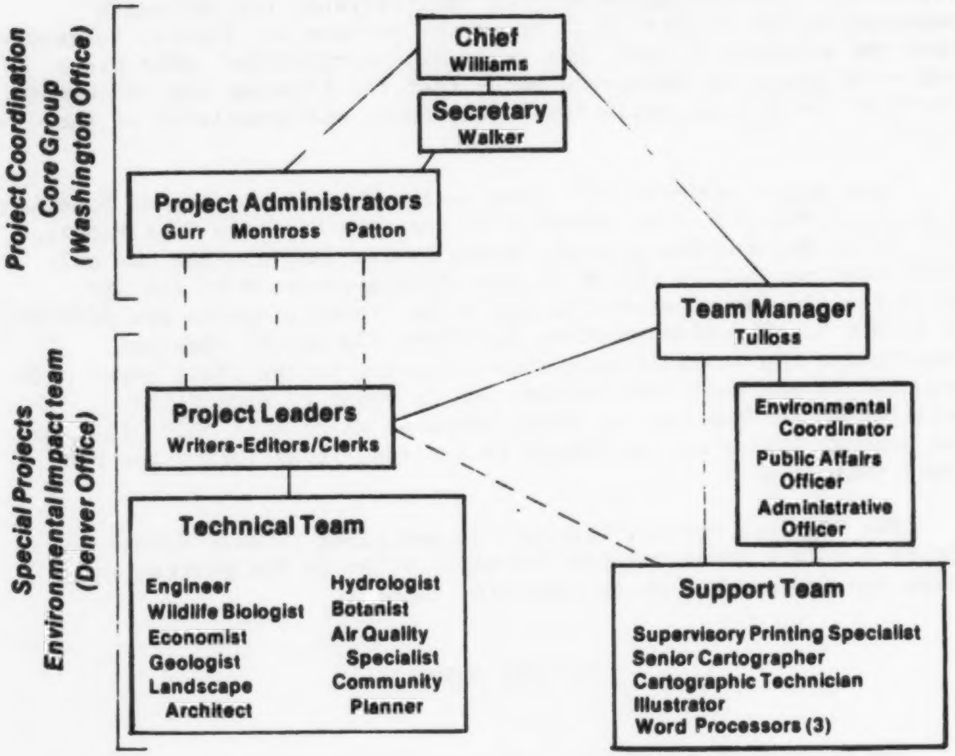
Energy projects are going to need either: 1) a right-of-way (R/W) grant for pipeline(s), such as BLM is issuing for the Alaska Natural Gas Line, the Northern Tier oil line, and the ETSI (Energy Transportation System, Inc.) coal slurry pipeline; or 2) a sale of public lands for a power plant (or synthetic fuel plant), as BLM did to the Intermountain Power Plant (IPP), and is considering for the Allen-Warner Valley Power Complex, the Deseret power plant, and proposals at Bisti, New Mexico and White Pine, Nevada. These power plants generally also need a transmission line R/W over the public lands, and other Federal lands (especially National Forests). BLM will also be considering coal gasification proposals, such as the Mountain Fuel plant in Utah, and oil shale facilities in Colorado and Utah.

Each of these projects involves a "major Federal action," -- the R/W grant or sale/use of land -- which requires an Environmental Impact Statement. BLM is, except in rare cases, the lead agency on these EIS's, BLM grants, each year, thousands of R/W's for small oil and gas pipelines.

Over the past few years, the Bureau has been heavily involved in major energy projects of national significance -- including the Trans-Alaska Pipeline (TAPS)and the SOHIO Pipeline from California to Texas. The Bureau has experienced the strain of dealing with projects which cover several States, and are large, complex, highly visible, and politically sensitive. That description is now applying to more and more projects requesting grants, permits, or sale of land from BLM. In the summer of 1979, BLM established the Office of Special Projects (OSP) to handle major Bureau (and Department of the Interior) projects that require special attention and coordination.

The Office of Special Projects has two major elements, as shown in Figure 1, the OSP Organization Table. The Washington office manages the projects and provides coordination with headquarters offices of BLM, DOI, and other Federal agencies. Of more interest to those involved in the EIS process is the Special Projects Environmental Impact Team (SPEIT), located here in Denver. It should be noted, however, this is a Washington Office located in the field, the only one of its kind in the Bureau. SPEIT is responsible for the entire EIS process, including application (and pre-application), scoping, preparing the draft and final environmental impact statements, and drafting the decision document. The 31 persons on the Special Projects Impact Team include the Team Manager and an Environmental Coordinator, who is responsible for the quality control

FIGURE 1. OFFICE OF SPECIAL PROJECTS ORGANIZATION TABLE



on all EIS's. A project leader is assigned to each project full-time for the entire EIS process, and has the ability to call on the 11 technical specialists, including an economist and a community planner. To make sure the EIS gets out on time, the team has a report production capability.

Responsibility for issuing the right-of-way grant, permit, or selling of land still rests with the appropriate BLM State Director. For pipelines crossing several States, one State Director has authority. The Washington project administrator for OSP stays involved in the project until after the permits are issued, to assure that the schedule is met, that necessary coordination takes place, and -- of great importance to us -- that the findings and recommendations of the EIS are reflected in the terms and conditions of the grant.

Four major projects have been assigned to the Office of Special Projects: The ETSI coal slurry pipeline, the Northern Tier Pipeline, the Alaska Natural Gas Transportation System (ANGTS), and our only non-energy project -- the MX Missile System proposed by the Air Force for the desert of Nevada and Utah. These projects are described in Figure 2. OSP also monitors the Trans-Alaska Oil Pipeline, coordinates the Bureau's activities relating to the Bisti power plant proposal in northwest New Mexico, and is about to accept the application for the Pacific Coast Pipeline which will ship oil from the central valley of California to Midland, Texas (along the proposed SOHIO route).

The "Special Project Process" is described in more detail in Figure 3. This paper relates the major steps in the process to needs for information about community impacts.

THE EIS PROCESS

The concept of the fully integrated EIS/decision process is one of the strong points of the Special Project approach to energy project management. There is a continuous flow, under sustained direction, from before the application is filed until after the grant is issued. The project is responsible for the pre-application/application, scoping, the EIS preparation plan, the draft and final EIS documents, the decision document, and the R/W grant of sale documents, including terms and conditions.

FIGURE 2. CURRENT OSP PROJECTS-FEBRUARY 1, 1980

The Office of Special Projects' current assignments are listed and briefly described below.

Energy Transportation Systems, Inc. (ETSI) - This project proposes a 1700-mile long subsurface coal slurry pipeline that will transport 37.5 million tons of coal per year from the Powder River Basin in Wyoming to electrical generating plants and markets in the South. The Wyoming State Office has been assigned the field responsibility. OSP is responsible for scoping, preparing the environmental impact statement (which is under contract), and drafting the decision document. George Gurr is the assigned Project Administrator, and Dick Traylor is the assigned Project Leader. Presently, the project is in the environmental impact statement preparation phase.

Northern Tier (NT) - On January 17, 1980, the President chose the Northern Tier pipeline for expedited permit treatment. This project proposes an approximately 1600-mile long pipeline to transport up to 933,000 barrels per day of crude oil from the west coast to Minnesota. The Montana State Office has the responsibility for issuing the right-of-way grants. OSP is providing the Washington Office coordination. Dan Patton is the assigned Project Administrator. Presently, the project is in the "expedited" permit granting phase.

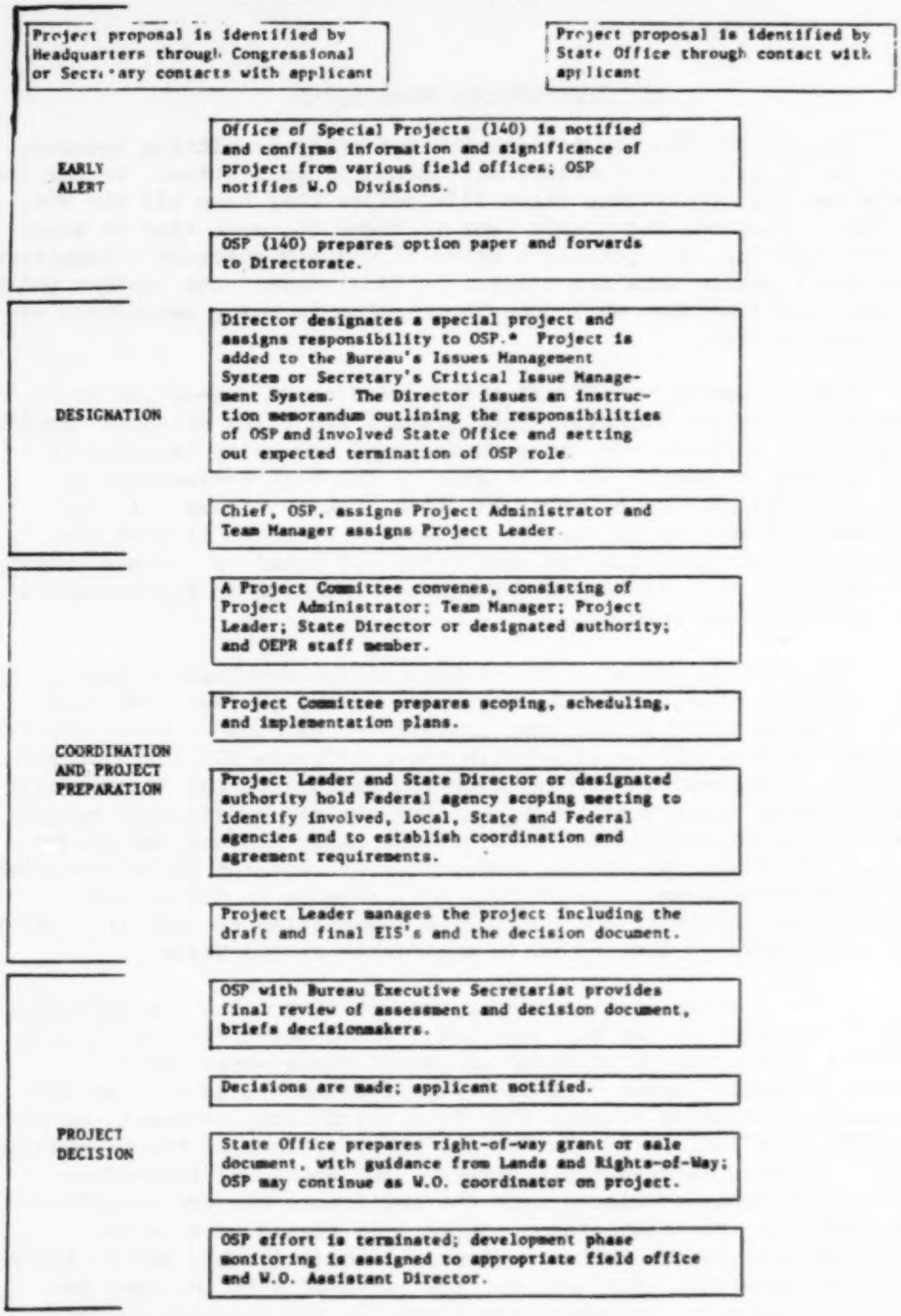
Mobile Intercontinental Ballistic Missile System (MX) - The Air Force is proposing to base 200 MX missiles on public lands in Nevada and Utah by the year 1986. The Air Force is the lead agency responsible for the environmental impact statement. The Nevada State Office has the field lead (working with the Utah State Office). The OSP has been assigned the responsibility for coordinating with the Air Force in its EIS preparation process to insure that effects on public lands and lightly populated regions are addressed. David Williams is the assigned Project Administrator and Bob Pizel is the assigned Project Leader. Presently, the project is in the scoping phase.

Alaska Natural Gas Transportation System (ANGTS) - This project proposes a 48-inch diameter pipeline to transport natural gas from the Prudhoe Bay oilfields to markets in Southern California and the Midwest. The proposed route parallels the Trans Alaska Pipeline route through Alaska and the Alcan Highway through Canada. Near the U.S. - Canadian Border, the route splits. The western leg follows an existing pipeline system

FIGURE 2. (CONTINUED)

to San Francisco. The northern border leg travels through Montana, North and South Dakota, and terminates in Iowa where it connects with existing pipelines leading to the Midwest. Field responsibility is assigned to the Alaska, California, and Montana State Offices. OSP is proving the Washington office coordination for BLM. Larry Montross is the assigned Project Administrator. Presently, the project is in the permit granting coordination phase for the western leg and northern border. The Alaska Natural Gas Transportation System Coordinator, in the Office of the Assistant Secretary, Land and Water Resources, has overall Departmental responsibility for ANGTS. OSP also serves as BLM's Washington Office monitor of the Trans-Alaska Pipeline.

FIGURE 3. SPECIAL PROJECT PROCESS



EARLY ALERT

- Project proposal is identified by Headquarters through Congressional or Secretary contacts with applicant
- Project proposal is identified by State Office through contact with applicant
- Office of Special Projects (140) is notified and confirms information and significance of project from various field offices; OSP notifies W.O Divisions.
- OSP (140) prepares option paper and forwards to Directorate.

DESIGNATION

- Director designates a special project and assigns responsibility to OSP.* Project is added to the Bureau's Issues Management System or Secretary's Critical Issue Management System. The Director issues an instruction memorandum outlining the responsibilities of OSP and involved State Office and setting out expected termination of OSP role.
- Chief, OSP, assigns Project Administrator and Team Manager assigns Project Leader.

COORDINATION AND PROJECT PREPARATION

- A Project Committee convenes, consisting of Project Administrator; Team Manager; Project Leader; State Director or designated authority; and OEPR staff member.
- Project Committee prepares scoping, scheduling, and implementation plans.
- Project Leader and State Director or designated authority hold Federal agency scoping meeting to identify involved, local, State and Federal agencies and to establish coordination and agreement requirements.
- Project Leader manages the project including the draft and final EIS's and the decision document.

PROJECT DECISION

- OSP with Bureau Executive Secretariat provides final review of assessment and decision document, briefs decisionmakers.
- Decisions are made; applicant notified.
- State Office prepares right-of-way grant or sale document, with guidance from Lands and Rights-of-Way; OSP may continue as W.O. coordinator on project.
- OSP effort is terminated; development phase monitoring is assigned to appropriate field office and W.O. Assistant Director.

*If not designated, project is assigned to appropriate State Office and W.O. Division

Pre-Application/Application

One of the biggest problems BLM and other permitting agencies have had is getting a complete and adequate application. To get the clock running, applicants often file before they have all the data needed. Sometimes they don't want to spend too much time or money before applying, and getting a sense of the BLM reaction. Sometimes they don't really have the project in final form; the project which changes its dimension while the application is being considered is all-too-familiar.

A more complete application is needed to do a good job of evaluating project impacts. That means a clear and detailed description of the project. For consideration of community impacts, it is necessary to know -- at a minimum -- the best projections of employment by number, by year, by skill, and by income. It is necessary to see the pattern of employment over the life of the project, and if possible the projections of local vs. outside hiring. It's helpful, too, to have the projected spending in the community for materials and services.

For the ETSI project, the project office developed a listing of the information needed at the beginning of the process; now that list is being tried on the next project -- the Pacific Coast Pipeline. The application will be filed with the California BLM State Office. Previous personnel are working with the applicant, the State Office, and the State government to obtain that quality application needed. The State government is involved because under BLM and CEQ guidelines, the office has the authority to prepare joint EIS's with State and local governments. California will require an EIS on the Pacific Coast project, and the OSP is negotiating to make it a joint one -- prepared by BLM and fully acceptable to the State.

At the pre-application stage, the OSP also makes the determination of who will do the EIS, and how. Under the Office of Special Projects, EIS's may be prepared in one of three ways: by the Special Projects Impact Team in Denver (in-house), as will be done on the Pacific Coast project EIS; by a third-party contract, as on the ETSI pipeline; or by the Federal applicant, as on the MX missile project. Under third-party contracts, the applicant identifies consultants (not associated with the applicant) who are qualified; BLM makes the selection; and a contract is signed between the applicant and the contractor. Payment is made direct, and no Federal funds are involved. BLM sets out the scope of work, manages the project closely, and prepares the final EIS and decision document.

A mix of the three techniques likely will be used for EIS preparation on BLM projects.

Scoping

The requirement of "scoping" as the first step in preparing an EIS was one of the significant changes in the CEQ (Council of Environmental Quality) regulations made in 1979. The scope of an EIS is the range of actions, alternatives, and impacts to be included in the document. Scoping determines the significant issues to be considered in the EIS; and identifies the insignificant issues which will not be considered.

In the ETSI project, the first go through the scoping process under the new office, the Federal agencies involved were identified: BLM, Forest Service, Fish and Wildlife Service, Corps of Engineers, and U.S. Geological Survey. Two Federal scoping meetings with these agencies (in Denver and Washington), and nine public scoping meetings along the length of the project (Wyoming to Mississippi) were called by BLM to identify and rank issues. At the public meetings, 469 people attended for presentations of the proposal; they then broke into work groups to assign priorities to the issues identified.

For the ETSI project, 249 people "voted" on the issues. More than half, 142, identified "subsurface water" as the most significant issue. Local socioeconomic impacts was second, with 51 votes and 49 were concerned about employment effects of the project. Concern was especially expressed about the construction phase impacts.

Based on these meetings, the Special Projects Impact Team prepared ETSI Coal Slurry Pipeline Proposal: A Report on Public Involvement in Identification of the Issues. A copy of this report was sent to every person who attended the scoping meetings, to State governments, and to interested Federal agencies. It played a key role in developing the preparation plan.

Preparation Plan

Following the scoping meetings, the SPEIT Project Leader called a meeting of the OSP staff (project administrator and project leader), the Department's Office of Environmental Project Review, the Fish and Wildlife Service (the EIS cooperating agency), the applicant (ETSI), and the contractor (Woodward-Clyde) to establish the preparation plan. The groups worked out how to do the project: what agencies are involved, how to coordinate with States, what staff are assigned, and what is to be the schedule. Primary attention was given to the allocation of resources to the issues identified in the scoping process.

Socioeconomic impacts were the second issue. The major sub-issues are long-term jobs and future water users, with secondary concerns about construction impacts. About one-fourth of the effort is devoted to socioeconomic impacts in the EIS, compared to about one-half for the primary issue — water. With completion of the Preparation Plan, and its approval by the Director of BLM, the EIS analysis is started.

EIS (Environmental Impact Statement)

The EIS addresses the issues identified in the scoping process, with the emphasis assigned by the preparation plan. For the ETSI project EIS, the chapter on "Affected Environment" will cover: water resources, socioeconomic considerations, vegetation, wildlife, aquatic biology, cultural resources, agriculture, air quality, recreation resources, transportation networks, and wilderness. Based on the scoping process, no sections will be prepared on geologic setting, climate, visual resources, noise, forestry resources, mineral resources, topography, or soils — sections which might apply to other EIS's, and which under the old guidelines would have applied to every EIS. The time and effort saved by narrowing the scope of the EIS can be applied, then, to the key issues, in this case, water resources and socioeconomic impacts.

For community impacts (used interchangeably with socioeconomic), we generally need to know: existing conditions (a baseline for the future without the project) and the conditions after the project. It will be the difference between the two which is defined as the "impact" of the project. Impacts from the construction and long-term operational phases of the project will need to be determined. Further, the OSP will need to have information in enough detail to assess what the problems are, and what can be done about them.

That is where models come in. It is my experience that the patterns of rapid growth from energy development are similar, that an experienced analyst can describe the population growth curve and identify major problems based on a knowledge of the existing community and the proposed project. Detailed information is needed -- information on who, when, and where. The who is numbers of people, by age, family size, and income. These characteristics will determine the impact on the existing community, and on the service needs for the new residents. The *when* is the phasing -- the schedule for impacts will do much to determine how severe they are. And finally, the *where* defines the location of the need. It is no longer enough to know the overall impact; it is necessary to know specifically what communities and jurisdictions are affected.

The specific "Socioeconomic Considerations" to be addressed in the chapter on "Environmental Consequences" in the ETSI EIS cover both construction, and operation, maintenance, and abandonment, all listed below:

Construction	Operation, Maintenance, Abandonment
Employment	Employment
Population Growth	Population Growth
Housing	Housing
Service Requirements	Service Requirements
Local Tax Revenues	Local Tax Revenues
Cost/Revenue	Cost/Revenue
Gross Regional Product	Gross Regional Product
Economic Related Activity	Economic Related Activity
	Economic Dislocations

Separate sections will address these impacts for the four major elements of the project: preparation plants, water supply system, slurry pipeline system, and dewatering plants. (This EIS does not consider the supplying coal mines nor the using power plants.) The service requirements are going to be more detailed; the IPP EIS, for example, considered: water, sewage, solid waste, education, law enforcement, fire protection and public health.

Though improvement is being made, EIS's have been slow to address -- and especially to address with any devotion -- the "socio-" portion of "socioeconomic" impacts. IPP discussed the "quality of life" as: employment, shopping, inflation, age, homogeneity/values, social and personal problems. The EIS, however, did not have any measures recommended to deal with any of these problems.

It can be expected that EIS's prepared by BLM will give much more consideration to social impacts. The Bureau is now embarking on a two-year program to identify and deal with the "Social Effects of the Federal Coal Management Program in the West." This cooperative program with the State governments no doubt will provide aid to

BLM's evaluation of major energy facilities as well. The project briefing document states one reason for moving ahead now is:

> 4. Existence of economic, demographic (population), and community service/facility models at Bozeman, Laramie, Fargo, Ft. Collins, and other locations. These automated approaches are operational and future work appears to be largely refinement-oriented. Understanding and projecting social effects remains a major scientific and administrative deficit.

Decision Document

The final step in the EIS process is the document sent to the President (as for Northern Tier), the Secretary of the Interior (as for IPP), or the Director of BLM (as will be done on the ETSI project). This document lays out for the decision-maker the options available, and the information available on the effects, advantages, disadvantages, costs and benefits, and mitigation measures of each option. To a large extent, this information will come from the EIS. In the Office of Special Projects, the same team that prepares the EIS will prepare the draft decision document. The major issues should flow right from the scoping process through the EIS to this decision document.

Not everything from the EIS will be in this document; in fact, the decision piece should be a compact distillation of the findings and recommendations of the EIS. Further, there will be some information in the document which came after the EIS, including the results of any negotiations between the Bureau and the applicant on mitigation measures.

The heavy reliance on the EIS, however, will be a significant improvement over previous practices, in which the connection between the two documents was not clear. Certainly the community impact of the project generally failed to make the decision document.

Summary

The place of community impact modeling in the BLM permitting process is in the full extent of the EIS process, from scoping through EIS preparation to the decision document. This is a major expansion from the present role of modeling.

COMMENTS AND SUGGESTIONS

The following points are made as helpful comments and suggestions on the role of modeling community impacts, and should not be considered as BLM positions related to its EIS process:

--EIS's in the past have given little attention to socioeconomic impacts, but this is being corrected.

--The major assessment of socioeconomic impacts is being done by models; we may have come, however, from the point of too few models to too many -- there must obviously be duplication, and the decisionmaker is hard put to decide which one to use.

--The EIS's and the models within them have been designed as "one-shot" affairs, not updated as information changes, as they must be.

--Some of the recent work on models has concentrated on the beauty of the methodology or the numbers, and not on its usefulness to evaluators, decisionmakers, or affected communities.

--EIS's have not developed mitigation measures for community impacts, and even the impacts themselves have not been carried forward to the decision documents.

--The discussion of community impacts has been heavily quantitative rather than qualitative. Social impacts have been given little attention beyond some vague reference to quality of life.

—Model makers, therefore, are going to have to:

- focus on the user of the information -- concentrate on what the decisionmaker needs to know, not what can be produced;
- be wary of employment projections provided by the applicant; they will invariably change (and usually for the worse);
- build in a capability to adjust to changed schedules (they will always change) and changed employment projections;

- give a range of potential impact -- it is the scale, direction, and timing that is important, not the precise number; in fact, using very precise numbers gives an impression of accuracy and validity that may not be there;

- use factors in the models which come from rapid growth experience or apply to rapid growth situations; national averages and "stable-state" characteristics are misleading, to say the least;

- address some of the qualitative questions through use of numbers, e.g., the number of unemployed wives;

- write clearly -- and briefly; and

- know when to quit.

PANEL COMMENT

LOCAL IMPACTS OF RESOURCE DEVELOPMENT

Jack D. Edwards [1]

ACTIVITIES OF BLM IN IMPACT ASSESSMENT AND RELATED POLICY ISSUES

The Bureau of Land Management is involved in a broad range of environmental impact statements since most major Federal land management actions have significant (and often controversial) effects on the quality of the human environment. The social and economic consequences on individuals, groups, communities, and regions are often substantial. People are an important part of the human environment and can express their concerns on how a specific project would affect their pocketbook or way of life.

BLM has the lead in preparing:

-145 grazing management EISs covering 170 million acres of Federal rangelands in the West, under a court mandate;

-12 timber management EISs on Federal timberlands, primarily in the Pacific Northwest;

-9 regional coal statements, with 2 to be completed this year, prior to additional leasing of Federal coal, and another scheduled for completion in 1981;

-7 outer Continental Shelf Oil and Gas Lease Sale EISs, which are targeted for completion in 1980-81.

In addition, BLM cooperates with other agencies in many other EISs--Air Force MX Missile Project underway in Nevada and Utah.

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[1] Project Leader, Office of Special Projects, Bureau of Land Management, Denver, Colorado

PRIORITY INFORMATION NEEDS FOR MORE EFFECTIVE IMPACT ASSESSMENT AND POLICY ANALYSIS

Information needs are defined to include both data and analytical models. A first prerequisite is to have competent economists/social scientists, preferrably on interdisciplinary teams near the action. Comprehensive automated data bases and sophisticated impact assessment models will be of limited value without a professional social scientist to apply to the study area and translate results for decisionmakers.

Summary Data Assessment

Economic and demographic data are generally adequate at the county level, although data are not always utilized correctly. There are continuing problems keeping data bases current and going below county level to deal with communities or individual users/operators. Social data, especially values and attitudes, are extremely limited and normally have to be acquired first hand in the area.

BLM has three projects underway to improve/expand our social and economic data bases:

1. Ranch Budget project - This is multi-year cooperative effort with ESCS, FS, and BLM. It is geared toward improving ranch operator cost and return data throughout the West in order to strengthen user and community impact analysis in Grazing Management Statements.

2. Census Users Group, Bureau of Census - has just completed a two-year project for BLM for an automated economic/demographic data (county) base with some data synthesis/analysis. Pilot applications have been made in five states. There is a need for continuing work to acquire sub-county data.

3. Social Effects of the Federal Coal Management Program in the West - Although this project will focus on social effects of coal development, it will benefit social analysis of other resource development programs in the region. A handout on its current status is available.

Analytical Models

Since models are abstractions from reality, they can be useful in giving indications of direction, but should not be expected to furnish precise numbers for exact future dates. As has been pointed out by Leistritz and others:

> -Models are tools for decisionmakers and don't replace decisionmakers and are not an end in themselves;
>
> -Models should be tailored or selected to fit situation, pocketbook, and timeframes;
>
> -There is a need for validity assessment of models.

David Betters, Colorado State University, conducted an abbreviated comparative analysis of two models that have been used frequently in BLM environmental statements. This included the Harris Model, used exclusively on the OCS oil and gas sale EIS; and DYRAM, applied mostly to BLM grazing statements.

Like much other good research, the comparison confirmed what was already suspected. The more sophisticated, expensive Harris Model was more appropriate for analyzing impacts on large complex regional economies (OSC, Coal Leasing), whereas DYRAM was more applicable for assessment of range and timber management proposals of a smaller magnitude in essentially rural economies.

SPECIFIC REACTIONS TO IDEAS PRESENTED IN PAPERS

The papers seemed to be for three audiences, or combinations thereof--model builders, model users, and decisionmakers. After elimination of two papers (Temple & Mankhaus-Adams) geared strictly for model builders, my brief critique was limited to the remaining three.

Bender-Parcels pointed up the need to be aware of structural changes in rural economies; and to document and incorporate changes in economic baseline conditions into analytical models, for more precise measurement for project-associated impacts. More specific guidance on how to go about incorporating structural changes into models would be helpful.

Murdock-Leistritz made three useful observations based on their assessment of selected impact models:

1. Recognize limitations of impact assessment models. Most of the current crop of impact models are limited to economic and demographic factors and do not cover social and environmental aspects.

2. Need to assess validity of models.

3. Need for selectivity in choosing (or tailoring) model to meet decisionmakers' needs and constraints.

Shriver's - Construction Labor Demand System (CLDS), coupled with compatible regional impact models, could provide improved estimates of direct-secondary jobs resulting from energy projects. Although this system has to be taken on faith until applications are completed, it would be useful in mitigating boom town impacts.

CONCLUDING REMARKS

So long as model-builders (economists) talk only with one another and confine their discussions to matters of technique rather than substance, there is a tendency to be clever rather than useful, to substitute assumptions for facts, and to be more concerned with the model (form) than with results. At the same time, decisionmakers have been remiss in failing to specify their modeling needs in reasonable timeframes and in providing necessary funding, while user translations of model results have often missed the mark. This workshop reflects a positive effort in reversing the situation by bringing model builders, users, and decisionmakers together for a constructive interchange of ideas and needs.

PANEL COMMENT

LOCAL IMPACTS OF RESOURCE DEVELOPMENT

Judith A. Davenport [1]

The Wyoming Human Services Project, begun in 1975, trains multidisciplinary teams to go into energy-impacted communitites and assist those communities to develop mitigation strategies to deal with their human services problems resulting from rapid growth. There are two major components to the Wyoming Human Services Project: a university-based training program (funded by the National Institute of Mental Health, DHEW) and a community-based service program.

The university-based component, housed at the University of Wyoming, includes a Project Director, Field Director, multidisciplinary teaching faculty and support staff. Students are recruited into a two-semester course aimed at developing skills in community development and human service delivery in impacted areas. These students, who must be seniors or in their last year of graduate school, are recruited from a variety of "people-oriented" disciplines, such as adult education, anthropology, communications, law, nursing, psychology, recreation and social work. The curriculum includes content on such topics: the nature and problems of impact communities, team building, establishing helping relationships, community organization, program planning and use of community resources. Upon graduation, teams of approximately five members are selected for one year appointments to the community-based program. These teams then receive additional intensive training for one month on campus and in the community.

In the community-based service program, team members, called Project Associates, go into impacted communitites which have requested assistance. Teams are financed by the local community from numerous sources, including the Economic Development Administration, municipal government, state government and energy companies. Team members are placed, at no direct salary cost to the agency, in settings related to their educational preparation. For example, a nurse might be placed in a mental health center.

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[1] Associate Professor and Director of the Wyoming Human Services Project, Department of Social Work, University of Wyoming.

Agency service personnel tend to be so overwhelmed with increased caseloads and new assignments that they welcome any form of assistance. Assistance is given through team members, who spend twenty hours per week providing direct services. This tangible help not only provides a needed service, but aids in securing community sanction for the team. "Project" team activities consume the remaining twenty or more work hours of each week. Team members, usually from five or so different disciplines, work together to help the community define impact-specific problems of service delivery and to design and implement measures intended to alleviate those problems.

Engaging in such activities and endeavors can be extremely difficult for existing agency personnel. Attempting to cope with the influx of people and problems may make them so "crisis-oriented" that they have virtually no time for planning and preventive measures. Such measures become more feasible with the assistance of Project Associates, who work closely with a community advisory board and local agency personnel to ensure local input and involvement in problem definition and solution. In effect, the community-based service component functions partly as a rural adaptation of a traditional social work program -- the health and welfare planning council, found in most urban areas and called by such names as Council of Community Agencies or Council of Community Services. Clearly, the thrust of the project is toward enhancing the community's ability and capacity to solve its own problems. Therefore, the team does not attempt to impose its own definitions of the problems. Problems are identified and addressed by the community with team members serving as catalysts, enablers and facilitators.

The Wyoming Human Services Project is in its fifth and final year of operation and is in the process of analyzing training and operations components. Much information related to working with human services agencies and providers has been gleaned through project experiences.

Providing technical assistance and facilitating planning efforts to these communitites has been both challenging and rewarding. Specific areas of concern are the lack of financial and other resources, lack of planning information, and lack of planning time. Tools for planning relating to human services and rapid growth are almost non-existent. Information now contained in the Environmental Impact Statements prove to be almost useless in assisting human services personnel to surmount the many "people" problems related to an expanding stress-ridden population.

Several suggestions related to improving the utility of EIS's for decisionmakers in human services could be made. The first, and most obvious, would be the inclusion of material related to human services in all EIS's. This information should include possible mitigation strategies and possible funding sources, if needed. Dave Williams' paper discloses that the Bureau of Land Management is moving toward that direction in its increased concern with socioeconomic impacts.

Some way of monitoring the degree of social change experienced in the community from the beginning of impacting would be extremely helpful. This would provide the community planners with information on an on-going basis so that they could adjust their planning and services for the changes occurring.

It would be extremely important for those persons who are hired to conduct the EIS's in the Rocky Mountain/Plains states to be from the West, or at least to have a thorough understanding of the values and culture of this part of the country. This is more significant in analyzing the social impacts than in projecting physical impacts. Human services delivery and the changes expected to occur due to rapid growth should be analyzed by someone from a human services background. Many social scientists are employed to conduct socioeconomic assessments but basically their assessments tend to be grounded solely in theory and have little relevance to practicality. Suggested mitigation strategies are either so global as to be meaningless to decisionmakers or else contain suggestions which are obvious but which do not contain problem-solving techniques.

If EIS's are to be relevant to human services providers and decisionmakers, then some of the above suggestions should be implemented. Communities experiencing problems of increasing populations need all the assistance they can receive in order to design well-planned communities.

PANEL COMMENT

LOCAL IMPACTS OF RESOURCE DEVELOPMENT: INTERIM REPORT ON THE HCRS/MCRO ENERGY-IMPACT PROJECT

Elise McNutt
Gage Skinner
Shelli Bischoff 1/

The HCRS Mid-Continent Regional Office began investigating energy impact issues in FY 80 owing principally to the expanding role of energy as a theme of national and regional signficance. Energy development, with all of its attendant social and economic consequences, particularly affects several western states in the Mid-Continent administrative area — notably Utah, Wyoming, Colorado, Montana, and the Dakotas.

Coal production is the cornerstone of the Administration's accelerated energy program. Contending that delays in fully exploiting America's coal resources can no longer be tolerated, a balance is being sought between often conflicting environmental and energy goals. An Interior Department report released in 1980 indicates that coal production on Federal lands was 100 million tons in 1979, a 25 percent increase from the 1978 level. By 1985, the report predicted that 200 million tons would be mined on Federal and Indian lands in the West, still a small percentage of what is expected to be 1.03 billion tons mined overall in 1985. Coal now accounts for more than 80 percent of United States' fossil fuel reserves but supplies only 18 percent of the country's energy needs.

In addition to rising demand for development of coal and for development of uranium resources, a tremendous effort is underway to advance a synthetic fuels program. Legislative initiatives in Congress are afoot to combat the energy crisis by creating a government/ industry partnership that would initially authorize spending $20 billion over 5 years to develop oil and gas from coal, shale rock, tar sands, and other non-traditional sources.

1/ Heritage Conservation and Recreation Service, Mid-Continent Region, P.O. Box 25387, Denver Federal Center, Denver, Colorado 80225

While energy and mineral development boom and bust cycles are not new to many western states, the coming decades promise to confront energy-impacted communities with disrupted local economies and altered social traditions on a scale perhaps not heretofore imagined. The entire spectrum of quality-of-life issues is surfacing in the context of the 1980's. The type and quality of public services that will be available to rapid growth communities is of increasing concern to both government and the private sector.

The role of the HCRS Mid-Continent Region should be clear: its business centers on recreation planning and development and on natural and cultural resource protection and preservation. HCRS conducts this business in a manner that is conducive to government/private sector partnership, and develops service programs with the conviction that public recreation and heritage values play a key role in sustaining the health, well-being, and social fabric of any community.

The challenge in the coming months is to ensure that these values are incorporated in the most effective way possible in response to requests for planning assistance from impacted communities.

The initial strategy has led HCRS to become an active partner in the broad-based energy development community. During FY 80, the objective has been to systematically identify those individuals, agencies, localities, and corporations which have a clear stake in the Region's energy development.

Field contacts by HCRS/MCRO energy team members have resulted in our own enlightenment about energy issues; in our acceptance and recognition as partners in addressing energy impact needs; in the identification of key pilot communities and areas toward which we will focus our assistance. The following is only a partial list of those communities HCRS now is serving on a pilot basis:

1. Ticaboo, Utah

2. Colstrip/Forsyth, Montana

3. Wright City and Hanna/Elmo Area, Wyoming

4. Craig/Meeker/Canon City/Paonia, Colorado

Further, HCRS is focusing attention on financial assistance, especially for front-end planning, citizen involvement, corporate involvement, and basic community self-help or planning strategies such as the park/school concept, fundraising, volunteerism, advisory councils, and so forth.

Two objectives designed to give practical application (transferability) of these strategies based on real, pilot project communities are: 1) a government/private sector-funded publication dealing with case studies on how impacted communities are solving problems and providing services in recreation and heritage preservation, and 2) an integrated regional workshop designed to address those issues, engaging the participation of all segments of the energy development community, with a lead role played by HCRS in formulating the agenda.

A more specific description of the HCRS/MCRO energy-impact team's activities to date is outlined below:

Collected a List of Selected Contacts Dealing with Energy-Impacted Areas, i.e., Public, State, Private, and Federal.

- Ticaboo, Utah. Coordinating role with the Utah Outdoor Recreation Agency and HCRS to ensure that recreation and cultural resource planning are fully examined and incorporated in joint site development formulated by Garfield County School District, Plateau Resources mining firm, Ticaboo Development Corporation, and architectural consultants. Special focus on the park/school recreation planning concept. Desired results: A planned unit development that does not take on the character of a "company town," that serves and stimulates the varied recreational interests and diversity of the development's residents and visitors, and that utilizes private sector commitments in the most efficient manner possible. Greater application of the HCRS "tool kit" strategies is expected as the Ticaboo development progresses, as well as a heightened awareness and action statement of the Utah Outdoor Recreation Agency to deal with Utah's impacted communities.

- Colstrip, Montana. In cooperation with the Western Energy Company, Wirth Associates, Inc., the Montana Department of Community Affairs, and other appropriate parties, HCRS will gather documentation relative to the history and development of Colstrip and Colstrip's park and recreation system. Of particular interest is an examination of labor productivity, turnover rates, attitudinal and social benefits, and facility design and placement. The objective is to determine the impacts of a park recreation program on an energy-development community with a track record of advance planning and citizen, private sector, and government involvement. What is the state-of-the-art at Colstrip? Are there common problems and common solutions transferable to nearby Forsyth and to energy-impacted settlements elsewhere?

- Craig/Meeker/Canon City/Paonia, Colorado. Provision of general and specific front-end planning assistance, including but not limited to formation of impact-oriented citizens' committees, formulation of a local citizen planning process, development of a student intern and adequate local master planning program, land acquisition strategies, park/school concepts, and other applicable "tool box" strategies in the HCRS Technical Assistance program.

- Wright City/Hanna-Elmo, Wyoming. HCRS proposes investigation into Wright City (ARCO), a planned unit development, also with a track record in front-end planning for recreation. An analysis will be done of the role of the recreation program in serving Wright City residents and addressing issues of labor productivity, social stability, citizen involvement, and other factors germane to Wright City's unique development. There will also be an examination of at least one other heavily impacted Wyoming area.

- Finally, additional selected examples of land acquisition or private sector involvement strategies in the HCRS, Mid-Continent Region, will be cited in the publication, again in the context of energy-impacted communities as they cope with this ever-expanding problem affecting the Nation's growth.

The Technical Assistance Division of HCRS is involved in energy-impacted areas for the purpose of understanding the recreation needs in a rapid growth area and of providing assistance in increasing recreation and preservation opportunities.

Special attention to the recreation needs of impacted areas will spur much needed analysis. More students are needed to provide rapid growth towns with the solid data to defend recreation planning and implementation. Recreation planning is needed early in the development stages to assure quality-of-life and deter social problems.

PANEL COMMENT

LOCAL IMPACTS OF RESOURCE DEVELOPMENT

Jean Ackerman [1]

I work with a firm that is involved in several energy impact situations; in each case the focus of our job is to provide technical assistance to the local government to handle the impacts, as opposed to designing impact measurement techniques.

I'm one of those people out in the trenches using the tools that you have developed and I'm here today to report on how well your tools are working for us, and people like us. Since I am an economist, I will primarily be addressing economic impact issues.

We seem to be in a second generation of impact assessment technology, where we have just begun to measure the effectiveness of our tools. Some preliminary test results are in and they are not encouraging.

Since there are no single accepted tools with which to measure employment or population, we tool users are using multiple techniques simultaneously. We cannot know absolutely whether one technique will be more accurate than another, prior to the impact; all we can know is whether the different techniques are producing radically different results. If they are, we know to investigate and explain the differences as best as we can.

There are a host of reasons why impact measurement techniques have failed to anticipate impacts accurately that are totally unrelated to the technique itself. The impactor may have needed federal legislation to provide development incentives or financing that never materialized; a labor strike or labor union problem may cause a total shift in the number and residence of the construction labor force.

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[1] Briscoe, Maphis, Murray, and Lamont, Inc., Boulder, Colorado.

Rifle, Colorado is one community that is tired and callous from hearing about the potentially severe population impact that may accompany oil shale development. The pounds of impact studies for the Rifle area address what will happen when the impact comes -- not how to prepare now for future development which may occur at some indefinite time.

Perhaps we in the energy impact field should focus more of our attention on developing ways to help impacted communities be flexible and responsive to energy impact when and if it occurs, rather than on ways to measure the impact more specifically. Housekeeping efforts such as insuring that local land development policies make new development support itself, structuring a tax system to capture the new impact, and improving the budget-making process are a few ways.

The policies available to the impactor with respect to housing, transportation, work week schedules, education, community facilities, etc. are powerful mitigation tools themselves. Rather than dramatizing the potential impact through a detailed numbers game, and developing grand, expensive capital improvements projects and programs to mitigate the impact, time may be more productively spent working with the impactor to understand how they might mitigate future potential impact before it occurs, thereby minimizing the potential impact in the first place.

I get the impression that many energy impact researchers, like true scientists, seek a controlled laboratory environment where the community stays constant, and impacts can be imposed and measured distinctly. We technical assistance people mess up the laboratory by trying our best to mitigate as we identify potential impacts, so that the eventual impact is imposed on a community that is as prepared fiscally, economically, and socially as possible.

At least in the area of economic impact, we have some identifiable tools to use and examine. Usable social impact techniques are hard to find. In absence of any defined social measurement technique, we are using a social impact panel of experts to review the economic impact results of one of our projects and to suggest the social impacts these economic effects may cause through a modified delphi technique. Our social "tool" is the composite grey matter of our panel of sociologists with prior experience in energy impact.

This is a pragmatic way to examine social impacts very specifically and is probably an improvement over a case study approach. Although we hope this approach is useful, we know our "tool" is not founded on social theory which can be tested in any way.

This technology-transfer workshop has given me some specific help, and I probably learned more than I offered. You may want to consider broadening the participants to include impacted community representatives in your future work sessions.

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